Metro State of Safety Report

A compilation of information on roadway-related crashes, injuries, and fatalities in the Portland Metro region and beyond

April 2012

Executive Summary

Between 2007 and 2009, there were 151 fatal crashes in the Portland Metro region, killing 159 people, and an additional 1,444 crashes resulting in incapacitating injury. Nationwide, crashes killed an average of 37,500 people per year between 2007 and 2009, and roadway safety remains one of the most challenging health issues nationwide.

It is the Portland Metro region's adopted goal to reduce the number of pedestrians, bicyclists, and automobile occupants killed or seriously injured on the region's roadways each by 50% by 2035 compared to 2005. This is an ambitious but important step toward realizing the larger vision of zero deaths.

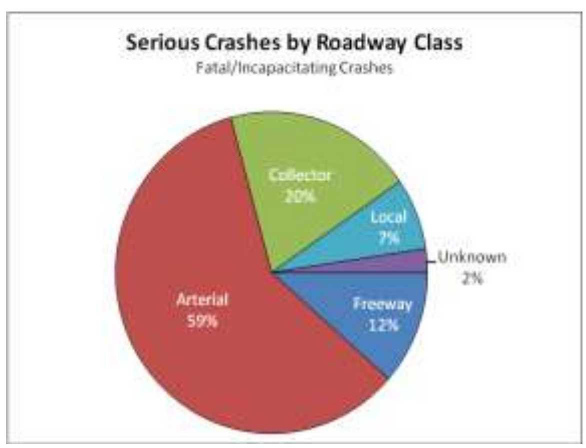
The purpose of this report is to document roadway crash data, patterns, and trends in the Portland Metro area and beyond to inform the pursuit of this goal. Beginning with 2007, statewide crash data are provided by the Oregon Department of Transportation, (ODOT). This is a rich dataset, including numerous information fields for each geocoded crash, and is complemented by Metro's rich datasets of transportation infrastructure, transportation operations, and spatial data. The combination of these provides the opportunity of detailed analyses of the safety of the region's transportation system and land use patterns.

Further, a huge amount of US and international data is available to document national and international patterns and trends. This information is important to provide context for local data.

Metro staff spent 2010 and 2011 working with staff from cities and counties of the Metro region, ODOT, TriMet, and other local safety experts to compile and analyze these data. This report presents the findings, identifying trends and relationships of serious crashes with environmental factors including roadway and land use characteristics.

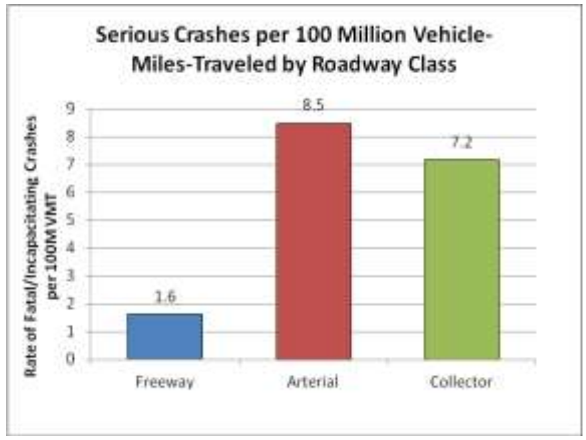
The findings include:

- Nationally and in Oregon, fatalities are decreasing year-to-year for all modes except motorcycle, which is increasing. *(Section 1)*
- Higher levels of vehicle miles travelled (VMT) correlate with more fatal and serious crashes due to increased exposure. (*Sections 1 and 8)*
- Arterial roadways comprise 59% of the region's serious crashes, 67% of the serious pedestrian crashes, and 52% of the serious bike crashes, while accounting for 40% of vehicle travel. Arterials have the highest serious crash rate per road mile and per VMT. (*Sections 2, 5, and 6, see figures at right)*

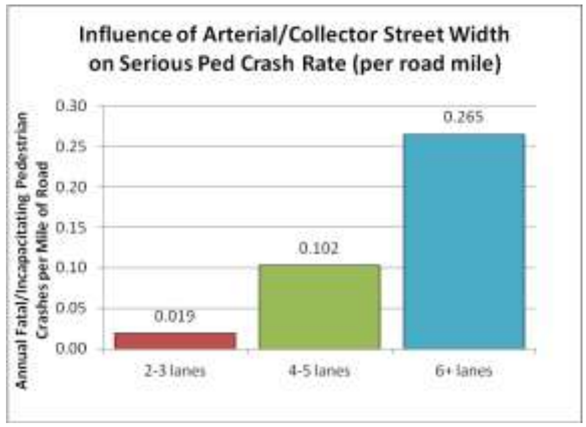


- Streets with more lanes have higher serious crash rates per road mile and per VMT. This follows trends documented in AASHTO's Highway Safety Manual. *(Section 3)*

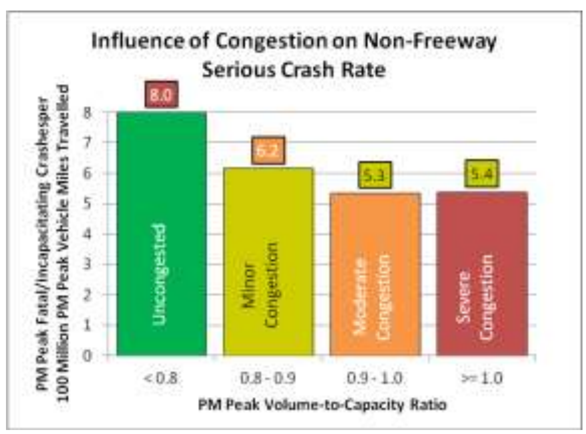
- Streets with more lanes have an especially high serious crash rate for pedestrians, producing higher crash rates per mile and per VMT as compared to other modes. *(Section 5, see figure at right)*



- The most common serious crash types were Rear End and Turning. For fatal crashes, the most common types were Pedestrian and Fixed Object. *(Section 3)*
- Alcohol or drugs were a factor in 57% of fatal crashes. *(Section 2)*
- Speed is a contributing factor in 26% of serious crashes, while aggressive driving is a factor in 40% of serious crashes. *(Section 2)*
- Aggressive driving was a factor in 86% of serious Rear End crashes. *(Section 7)*
- Occupants without seat belts were three times as likely to be seriously injured in a crash as those with seat belts. *(Section 2)*



- Serious pedestrian crashes are disproportionately represented after dark. While 29% of all serious crashes happen at night, 45% of serious pedestrian crashes happen at night. (*Section 5)*
- Nighttime serious pedestrian and bicycle crashes occur disproportionately where street lighting is not present. 79% of serious pedestrian crashes and occurring at night and 85% of serious bicycle crashes occurring at night happen where lighting is not present, as compared to 18% of all serious crashes occurring at night. *(Sections 5 and 6)*
- Higher levels of congestion on surface streets appear to result in lower serious crash rates across modes, likely due to lower speeds. *(Section 3, see figure at right)*



- Higher levels of congestion on freeways appear to result in higher serious crash rates, except for severe congestion, which results in lower serious crash rates, likely due to lower speeds. *(Section 4)*
- Travel by transit is relatively safe, with no passenger deaths in the study period, and 0.23 deaths involving a transit vehicle per 100-million-transit-passenger-miles. For comparison, the rate for all traffic was 0.42 deaths per 100-million-motor-vehicle-passenger -miles. *(Section 9)*

The Regional Transportation Plan calls for a 50% reduction in fatalities plus serious injuries for pedestrians, bicyclists, and motor vehicle occupants by 2035 as compared to 2005. Based upon the findings of this study, strategies for implementation should include:

Strategies	*Rationale*
A regional arterial safety program to focus on corridors with large numbers of serious crashes, pedestrian crashes, and bicycle crashes.	*Arterials have the highest serious crash rate for all modes, and should be the primary focus of regional safety efforts.*
Safety strategies that match solutions to the crash pattern and street and neighborhood context, rather than an approach of simply bringing roadways up to adopted standards	*Many of the region's high-crash corridors meet or largely meet adopted design standards. More creative solutions are needed to make substantive safety improvement.*
Highway Safety Manual strategies to address arterials, such as medians, speed management, access management, roundabouts, and road diets	*The Highway Safety Manual includes proven design strategies to substantively improve safety.*
Policies that reduce the need to drive, and therefore reduce vehicle-miles travelled	*Reducing the miles people need to drive reduces their exposure and likelihood of being in a crash in the first place.*
Strategies to reduce the prevalence of speeding and aggressive driving on surface streets	*Speeding and aggressive driving are common contributing causes to crashes, and high speeds increase crash severity.*
Strategies to reduce the mixing of alcohol or drugs with driving	*More than half of the region's fatal crashes involve drugs or alcohol.*
Revisions to state, regional, and local mobility standards to consider safety as equally important, at a minimum, as vehicular capacity	*Policies which prioritize capacity over safety encourage wider, faster streets which have been demonstrated to be less safe in an urban environment.*
A focus on crosswalk and intersection lighting where pedestrian activity is expected	*Pedestrians are disproportionately hit by vehicles at night. Night crashes are disproportionately where street lighting is lacking.*
Policies to improve the quality and frequency of pedestrian crossings on arterials and multi-lane roadways	*Arterials and multi-lane roads are particularly difficult for pedestrians to cross, but crossings are needed to access transit and other daily needs.*
A focus on safe cycling facilities and routes, particularly in areas where serious crashes are occurring	*Strategies are needed to safely accommodate cyclists in order to reduce serious crashes while mode share increases.*
More detailed analysis of the causes of serious crashes, pedestrian crashes, and bicycle crashes in the region	*This report identifies high-level trends in regional crashes, but more detailed work is needed to identify specifically where and why they are occurring in disproportionate amounts.*
More detailed research on the relationship between land use patterns and safety	*The analysis performed for this report identified some trends, but many relationships remain unclear. More research is needed to recommend reliable land use strategies.*

Table of Contents

Introduction

It is the Portland Metro region's adopted goal to reduce the number of pedestrians, bicyclists, and automobile occupants killed or incapacitated on the region's roadways each by 50% in 2035 compared to 2005.

The purpose of this report is to document roadway crash data, patterns, and trends in the Portland Metro area and beyond to inform the pursuit of this goal. Beginning with 2007, statewide crash data are provided by the Oregon Department of Transportation, (ODOT). This is a rich dataset, including numerous information fields for each geocoded crash, and is complemented by Metro's rich datasets of transportation infrastructure, transportation operations, and spatial data. The combination of these provides the opportunity of detailed analyses of the safety of the region's transportation system and land use patterns.

Further, a huge amount of US and international data is available to document national and international patterns and trends. This information is important to provide context for local data.

In this report, crashes are broken down by a number of factors contained in the dataset provided by ODOT.

- Injury Type: Each crash is identified by the worst injury incurred in the crash: Fatal, Injury A (incapacitating), Injury B (moderate), Injury C (minor) or Property Damage Only (PDO). This report largely focuses on Fatal/Incapacitating crashes (the sum of Fatal and Injury A), referred to as 'Serious Crashes' throughout this report. These are the types of crashes that the region is primarily focused on eliminating.
- Location
- Date and Time
- Weather and Pavement Conditions
- Roadway Location: the location on the roadway system allows data from Metro's mapping databases to be attributed to the crash.
- Contributing Factors: These include speeding, alcohol, drugs, school zone, work zone, and hit and run.

Metro's mapping database includes:

- Roadway data, such as speed, geometry, traffic volumes, traffic congestion, transit routes, bicycle routes, and sidewalk inventory
- Spatial data, such as land use, population, density, socioeconomic factors, and walkability

Note that many figures in this document are in color, and while colors are generally selected to be legible when printed in black and white, they are most readable in full color.

Definitions

Terms that are used throughout this report are defined as follows:

"**Portland Metro region**" is the scope of this study, and is defined as area within the Urban Growth Boundary (UGB) as of December 31, 2011.

"**Injury A**" and "**Incapacitating injury**" are used interchangeably. Incapacitating injuries typically are injuries that the victim is not able to walk away from. They are synonymous with the term "**Severe injury**"

"**Injury B**" and "**Moderate injury**" are used interchangeably.

"**Injury C**" and "**Minor injury**" are used interchangeably.

"**Serious Crashes**" in this report refers to the total number of Fatal and Injury A crashes.

Per capita is used to describe crash rate per population. Except where otherwise noted, crash rates are per million residents.

Per VMT is used to describe crash rate per vehicle miles. Except where otherwise noted, crash rates are per 100-million vehicle miles travelled.

Arterial is a functional classification for surface streets. AASHTO defines arterials from the motor vehicle perspective as providing a high degree of mobility for the longer trip lengths and high volumes of traffic, ideally providing a high operating speed and level of service and avoiding penetrating identifiable neighborhoods.

Collector is a functional classification for surface streets. AASHTO defines collectors as providing both land access and traffic circulation within neighborhoods and commercial and industrial areas. The role of the collector system, from the motor vehicle perspective, is to distribute traffic to and from the arterial system.

Local is a functional classification for surface streets that includes all public surface streets not defined as arterial or collector. Local streets are typically low-speed streets with low traffic volumes in residential areas, but also include similar streets in commercial and industrial areas.

Section 1 – State, National, and International Trends

Data from the National Highway Traffic Safety Administration (NHTSA) were compiled and analyzed along with population data from the US Census to identify trends in national, state, and city crashes. NHTSA summarizes traffic fatality data by state and by major city, including number of fatalities, fatalities per capita and per vehicle-miles travelled (VMT), and by travel mode. Five years of data between 2005 and 2009 were considered for this analysis.

Travel and Fatality Patterns: US and Oregon

Travel patterns in the US have changed in the last decade due to a variety of external factors. While the population has continued to increase, VMT per capita and absolute VMT have declined. Roadway fatality rates have begun to decline after decades of increases or stagnation. In Oregon, these trends are consistent with national patterns. Figures 1-1 and 1-2 show the national and state trends of population, VMT, and crash-related fatalities.

Figure 1-1

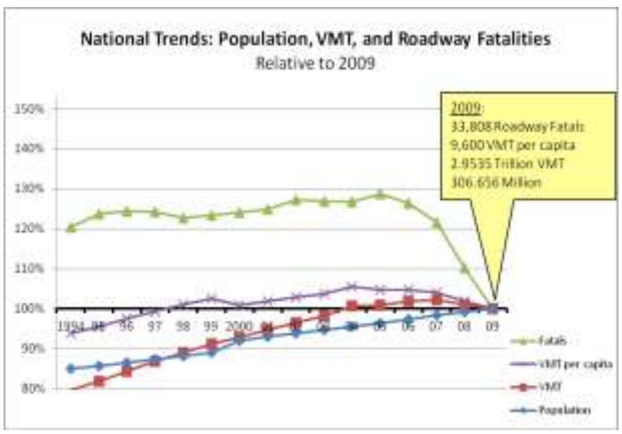
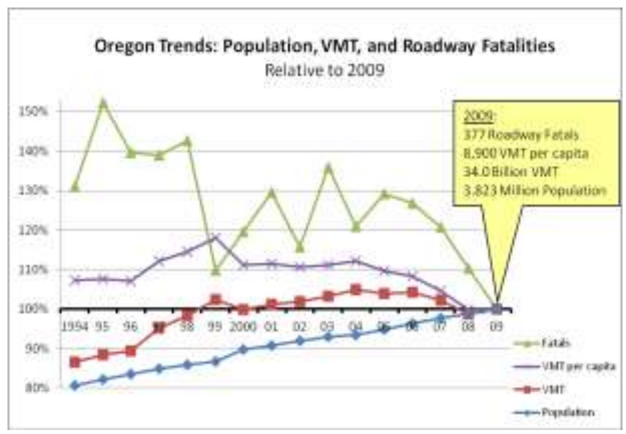


Figure 1-2



It is common practice to normalize roadway fatality rates by both population and traffic volumes. Normalization by population is useful in measuring the overall safety of the roadway system. Normalization by traffic volumes is useful in measuring the safety per distance travelled. Figures 1-3 and 1-4 show national and state trends for fatalities and fatality rates.

Figure 1-3

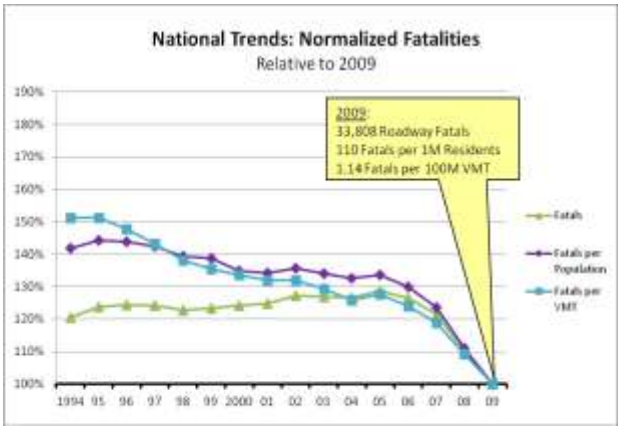
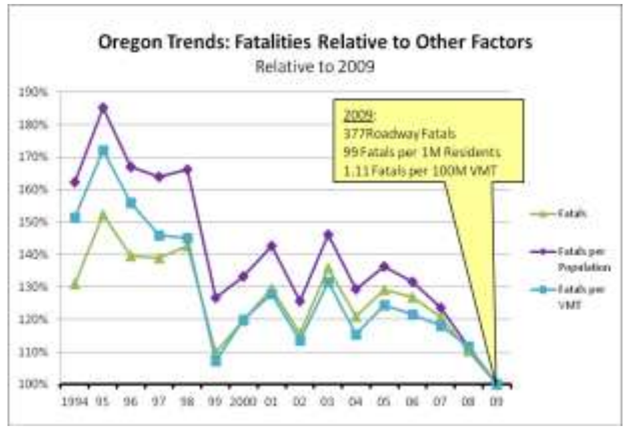


Figure 1-4



Total fatalities, fatalities per capita, and fatalities per VMT are all decreasing over time.

Fatality Patterns by Mode: US and Oregon

The NHTSA data are broken out by mode: automobile occupants, motorcyclists, bicyclists, and pedestrians. Figures 1-5 and 1-6 show the recent national and state trends for each mode.

Figure 1-5

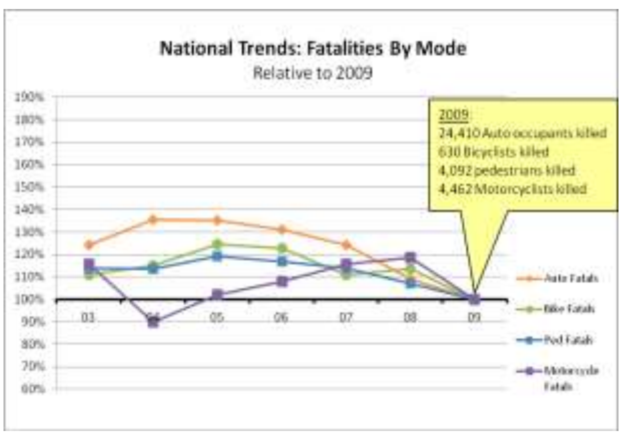
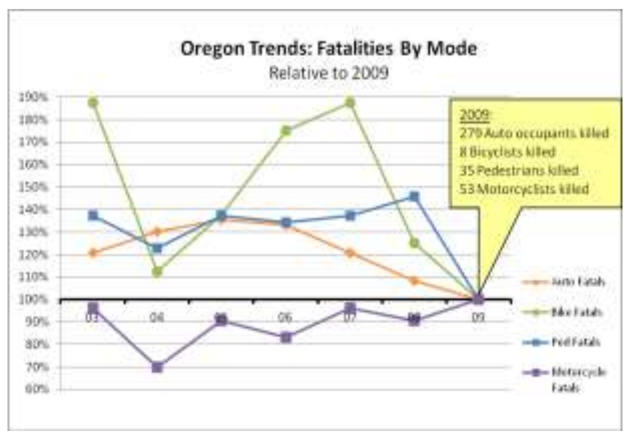


Figure 1-6



Fatalities are decreasing over time for all modes except motorcycle, which is increasing.

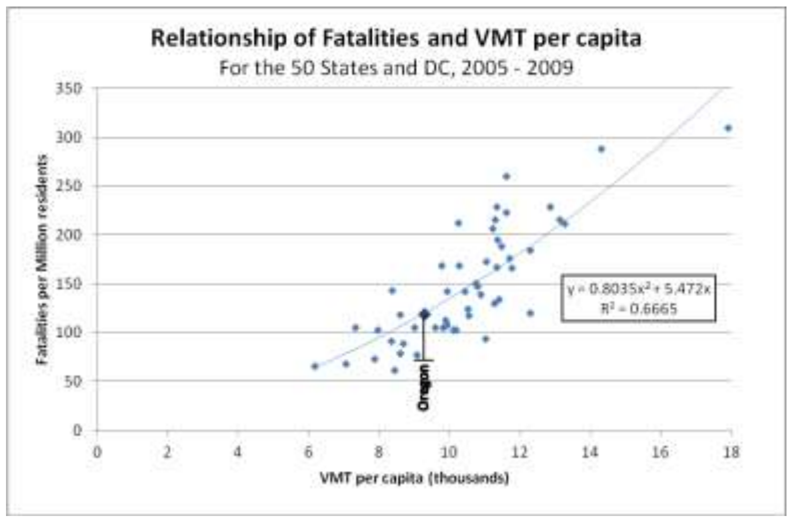
Annual Vehicle-Miles Traveled (VMT)

One of the clearest trends in crash data is the correlation between fatality rates and annual per capita VMT. Figure 1-7 shows the relationship by US state for all fatalities, and Figure 1-8 shows the relationship for pedestrian or bicyclist fatalities.

States with higher VMT typically also have higher per capita fatality rates, as the typical exposure to risk is increased. A polynomial equation with a good R-squared value can be fitted to estimate the change in roadway fatalities that would occur by changing per capita VMT, and is shown in Figure 1-7.

All Fatalities

Figure 1-7



It is apparent from the data that states with more auto travel typically exhibit higher fatality rates. The District of Columbia has the lowest per capita VMT at 6,170, and exhibits one of the lowest annual fatality rates of 65 per million residents – 50% of the national average. Massachusetts, New York, and Rhode Island have the next lowest VMT per capita, and exhibit some of the lowest fatality rates in the US. Wyoming, with the highest per capita VMT of 17,900, also has the highest annual fatality rate at 310 per million residents – 235% of the national average.

A polynomial equation with a good R-squared value can be generated for the VMT-fatality relationship by setting the intercept to zero. While the equation is likely to vary slightly year-to-year, the general relationship is likely permanent. The relationship for 2005 – 2009 data is shown in Figure 1-7.

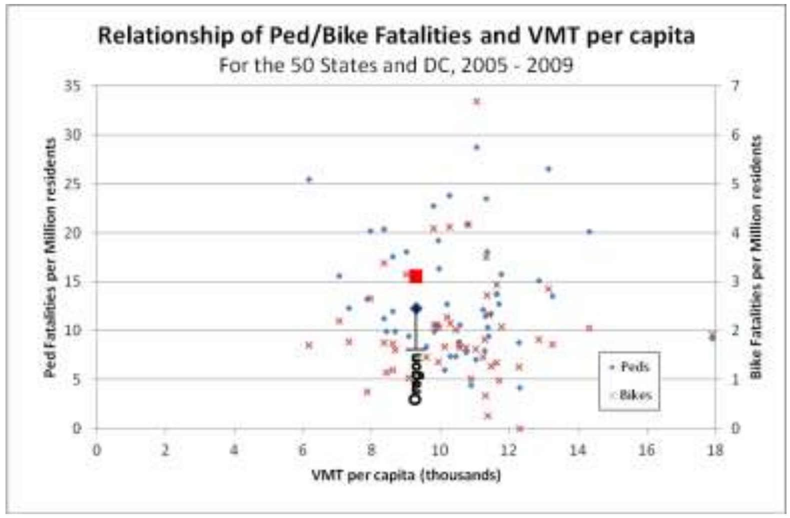
The national average is 9,920 VMT per capita and 132 fatalities per million residents.

Oregon statistics are 9,280 VMT per capita (94% of the national average) and 119 fatalities per million residents (90% of the national average).

Ped/Bike Fatalities

The relationship between statewide VMT per capita and ped/bike fatalities is unclear. As can be seen in Figure 1-8, the data are scattered, and unlike the overall fatality data, no clear trend exists. This may be due to the complex relationships at play – higher VMTs make ped/bike travel more dangerous, but discourage travel by these modes thereby reducing ped/bike exposure. Florida is the worst state in the nation for both pedestrians killed at 28.7 per million residents and cyclists killed at 6.7 per million residents.

Figure 1-8

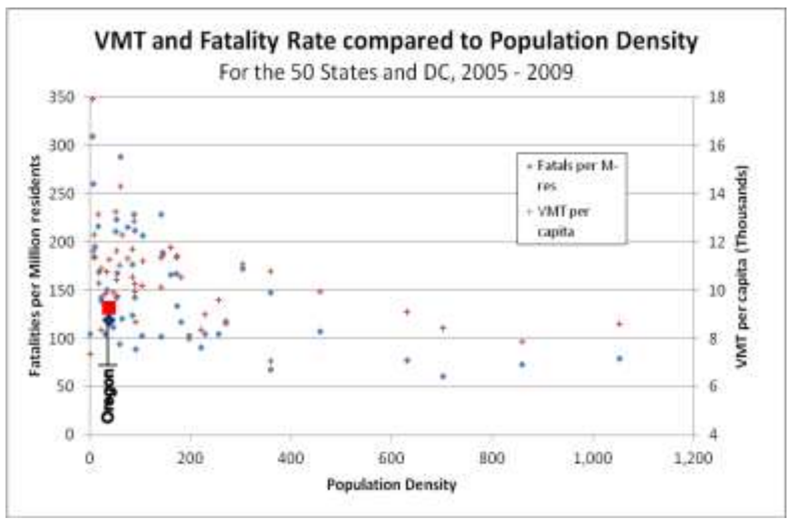


The national average is 15.1 pedestrians killed in crashes per million residents and 2.4 cyclists killed in crashes per million residents.

Oregon crash statistics are 12.3 pedestrians killed per million residents (81% of the national average) and 3.1 cyclists killed per million residents (130% of the national average).

Population Density

Figure 1-9



Given that VMT plays such an important role in crash rates, population density is a logical factor to consider. Density would be affected by the proportion of the population living in large cities, and higher densities would be expected to reduce the need for auto travel.

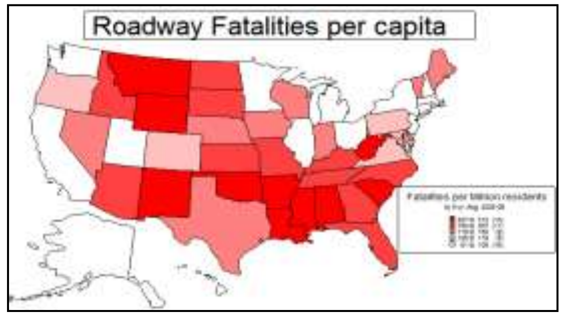
Figure 1-9 shows the relationships between population density and both VMT and fatality rates. While both generally decline with increasing density, the relationship is more random than the relationship between VMT and fatality rates.

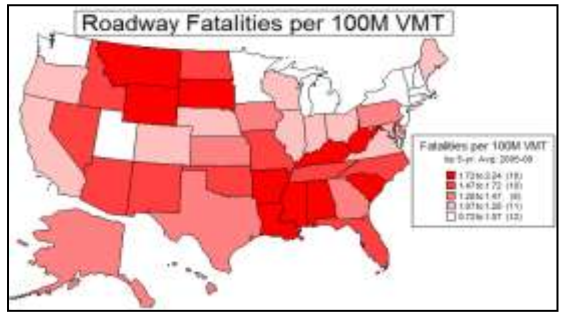
The relationship between population density and crash rates appears to be indirect, in that density reduces crashes largely by reducing the need for automobile travel.

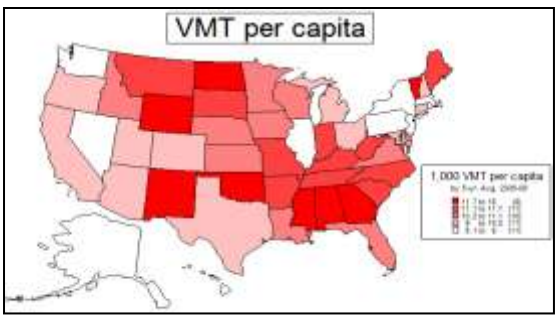
State-by-State Fatality Trends

Figures 1-10 through 1-13 show the variation of fatality rates, VMT, and population density among the states. The consistency among states with high fatality rates and high VMT per capita is clearly evident. Interestingly, many states with high VMT per capita also exhibit high fatality rates per VMT – particularly the southeastern and Mountain West states. The result is very high fatality rates on a per capita basis. This is why a polynomial equation fits the relationship between fatalities and VMT (Figure 1-7) better than a linear one.

Figures 1-10, 1-11, 1-12, and 1-13







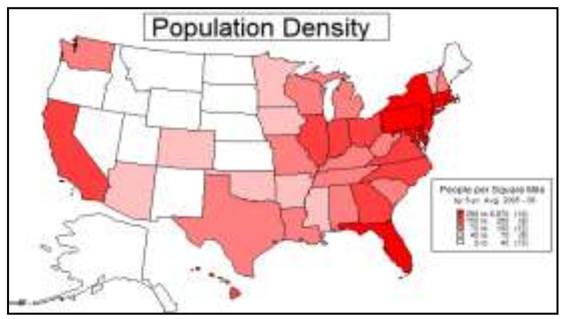
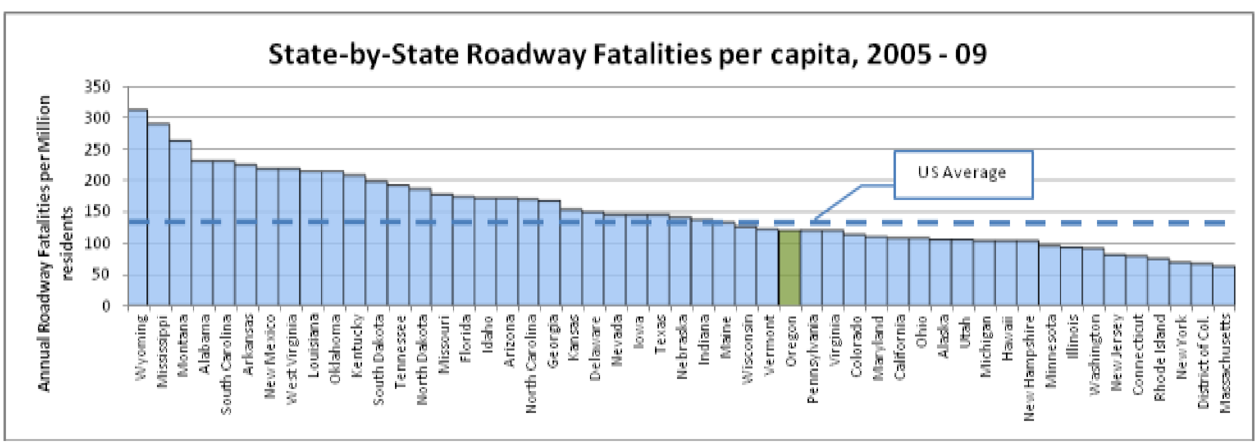


Figure 1-14 shows the per capita fatality rate by state. Oregon is slightly better than the US average.

Figure 1-14



European Data

Data from the EU Road Federation's publication "European Road Statistics 2010" were compiled in order to provide a comparison to US data. European practices are often considered as a best practice as their transportation systems are generally safer and more efficient than US systems.

Figures 1-15 and 1-16 present European roadway fatality rates per capita and per VMT.

Of the 27 EU countries, 21 of them exhibit lower rates of roadway fatality per capita than the US average. On a per-VMT basis, 16 of the 27 exhibit lower fatality rates than the US average.

Figure 1-15

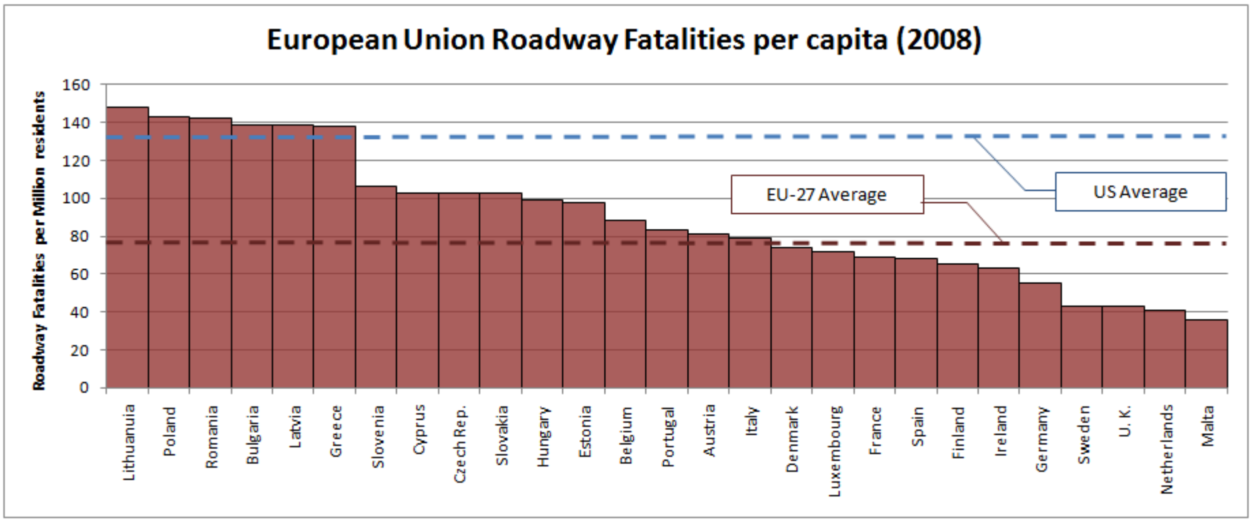
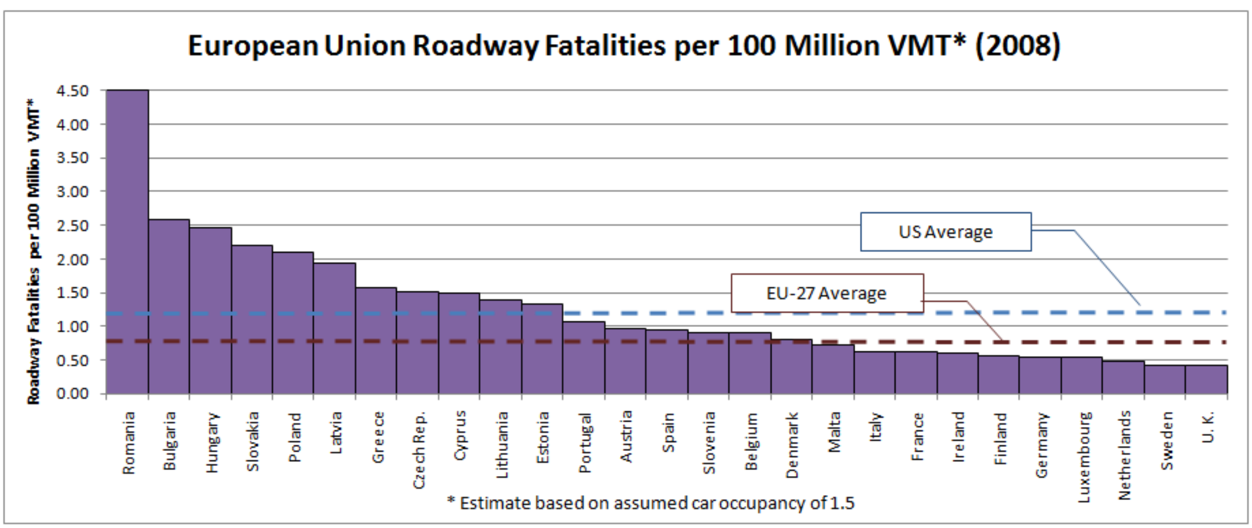


Figure 1-16



European countries appear to be limiting roadway fatalities both by managing safer roadways and developing transportation systems and development patterns which require less driving.

US City Data

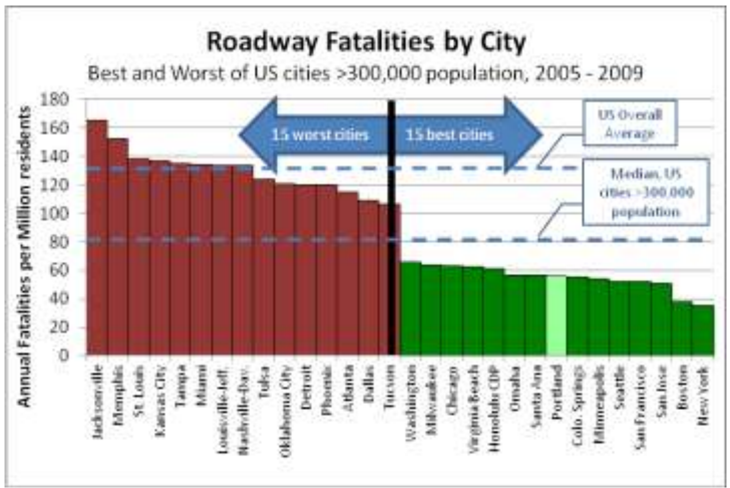
NHTSA data include counts of all fatalities and pedestrian fatalities in US cities. This information is of special concern for this report given the Portland Metro region's existing level of urbanization, and that the adopted growth concepts call for accomodating growth by increasing urbanization.

The figures below summarize overall fatality rates and pedestrian fatality rates for the best and worst 15 cities with population above 300,000. The figures are five-year averages (2005 – 2009).

Overall fatality rates

The worst cities in the nation for overall fatality rates are Jacksonville, Memphis, St. Louis, Kansas City (Missouri), Tampa, and Miami. These include all three Florida cities and both Missouri cities over 300,000 population. The city of Orlando does not meet the population threshold, but exhibits a fatality rate even higher than any of the cities listed, continuing the trend of danger in Florida's cities. In general, the worst cities are in states which have invested primarily in roads, such as Florida, Texas, Michigan, Oklahoma, and Arizona.

The safest cities in the nation in terms of roadway fatalities per capita are New York, Boston, San Jose, San Francisco, and Seattle. In general, the safest cities are those that exhibit dense urban environments and may have higher usage of non-auto travel modes.

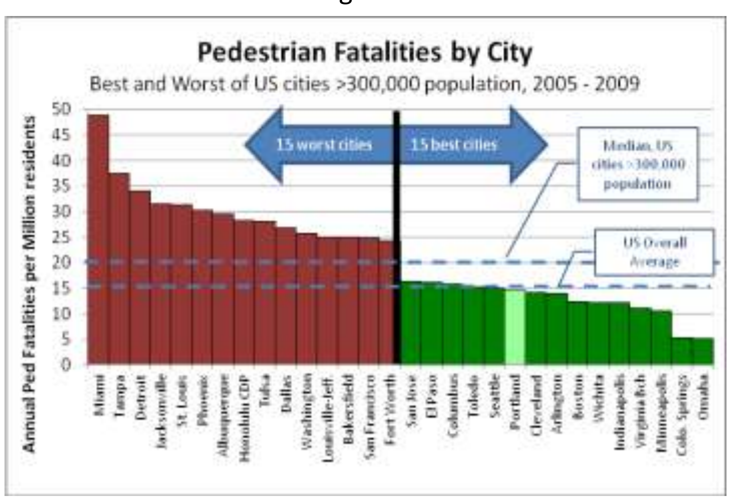


The city of Portland ranks well in this list, at 8th best out of the 62 cities of population 300,000 or more.

Figure 1-17

Pedestrian fatality rates

Figure 1-18



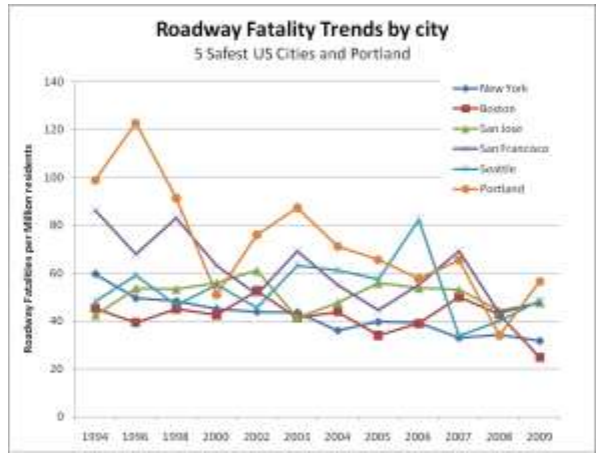
The worst cities in the nation for pedestrian crash fatality rates are Miami, Tampa, Detroit, Jacksonville, and St. Louis. If Orlando were included, it would be the 3rd worst. Again, Florida cities perform very poorly from a safety perspective. Many of the most dangerous cities for pedestrians are in states which have invested primarily in roads, although several cities with lots of multimodal investment and activity – such as Washington DC and San Francisco – rank poorly as well.

The safest cities in the nation for pedestrians per capita in terms of crash fatalities are Omaha, Colorado Springs, Minneapolis, Virginia Beach, and Indianapolis. None of these are widely known to exhibit particularly high rates of pedestrian activity, so the low fatality rates may be a combination of less pedestrian exposure and a relatively safe walking environment.

The city of Portland ranks well in this list, at 10th best out of the 62 cities of population 300,000 or more.

Overall fatality trends in cities

Figure 1-19



Crash fatality rates are generally declining in large US cities. This figure shows trends between 1994 and 2009 for the five safest cities of population 300,000 or greater and for Portland.

The city of Portland has exhibited fewer roadway fatalities in the past five years than prior periods, consistent with statewide trends, and is one of the leading US cities in percentage reduction of fatalities in the time period 1994 to 2009.

Discussion

In general, overall fatality rates per capita in cities are less than the national average for all areas. For example, the city of Portland's average annual fatality rate of 56 fatalities per million residents is much less than the national average of 132 and the Oregon statewide average of 119. Eight of the 62 cities exhibited crash fatality rates above the overall national average, with 54 exhibiting crash fatality rates below the national average.

This is likely due to a number of factors including fewer miles driven per capita due to the proximity of services, and the lower speeds of urban streets compared to rural highways, resulting in lower crash severity.

In general, cities which are more urban and which have invested in a variety of modes of transportation show substantially lower overall crash fatality rates. Those which have invested disproportionately in auto infrastructure exhibit higher crash fatality rates.

Florida cities offer a clear example of what not to do. Florida cities are characterized by wide, high-speed multi-lane arterials (often 6 or more lanes) with poor access management, disconnected street systems, and low intensity land uses. Historically, planning based on transportation concurrency contributed to the development of these roadways as well as the sprawling nature of Florida's cities, resulting in a focus on motor vehicle mobility with little regard for safety or multi-modal access. More recently, Florida has made progress in revising concurrency policies to arrest these trends, adopting concurrency exception areas in many cities, and developing multi-modal level of service policies. Policies that consider land use and transportation in a broad context, and avoid prioritizing vehicle capacity over other considerations, are an important element of building a safe transportation system.

Regarding pedestrian fatality rates, the relationships are complex, as cities with better pedestrian infrastructure encourage use by people walking, thereby increasing exposure. So while it may be safer to walk a given distance, the increased walking that results may increase pedestrian exposure and thus pedestrian crashes. San Francisco is a good example of this, with the 14th worst pedestrian crash fatality rate but the 4th best overall crash fatality rate. Increasing walking may lead to more pedestrian fatalities because of the increased exposure but fewer overall fatalities because of the reduced VMT.

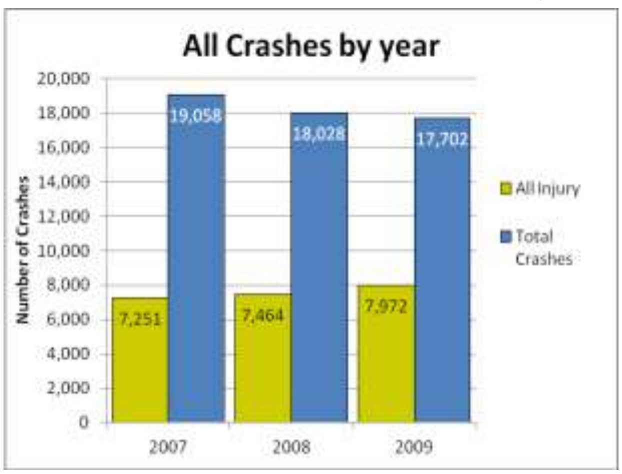
Section 2 – All Crashes

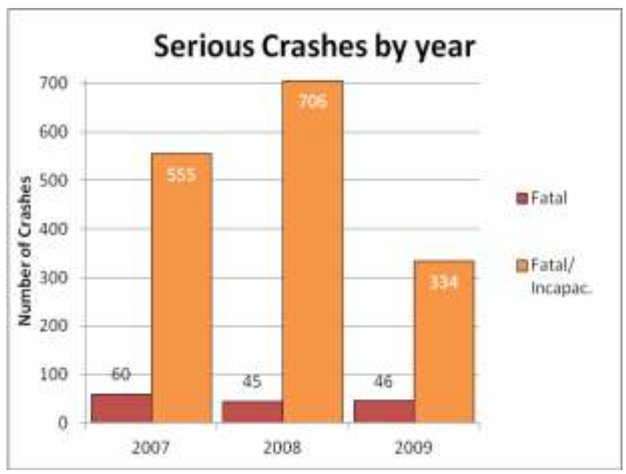
This section summarizes all crashes occurring in the Portland Metro region. The term "serious crashes" refers to all fatal or incapacitating injury (injury A) crashes.

Crashes By Year

Year	Total Crashes	Fatal Crashes (Fatalities)	Injury A Crashes	Injury B Crashes	Injury C Crashes	All Injury Crashes (Injuries)	Fatal/ Incapac.
2007	19,058	60 (63)	495	2,050	4,706	7,251	555
2008	18,028	45 (49)	661	1,864	4,939	7,464	706
2009	17,702	46 (47)	288	1,806	5,878	7,972	334
Total	54,788	151 (159)	1,444	5,720	15,523	22,687 (31,179)	1,595

Figures 2-1 and 2-2





Total crashes declined over the 3-year period, while injury crashes increased over the 3-year period (Figure 2-1). Fatal and serious crashes fluctuated over the 3-year period (Figure 2-2).

Metro crash rates compared to other places

Year	Population (2010)	Annual VMT	All injury		Serious Crashes Fatal/Incapacitating	
			per million residents	per 100M VMT	per million residents	per 100M VMT
2007-09	1,481,118	9,308,676,259	5,106	81.2	359	5.7

2007 - 2009	Avg. Annual Fatalities	Population	Annual VMT	Fatality rate per million residents	Fatality rate per 100M VMT
Metro	53.0	1,481,118	9,308,676,259	36	0.59
City of Portland	27.7	583,627	4,376,272,685	47	0.66
Oregon	416	3,779,734	34,100,000,000	110	1.22
Median, cities >300,000 pop.	-	-	n/a	81	n/a
US	37,376	304,041,341	2,984,500,000,000	123	1.25
UK (2008)	2,645	60,776,238	630,000,000,000*	43	0.42
EU – 27 (2008)	38,875	490,426,060	4,520,000,000,000*	78	0.86

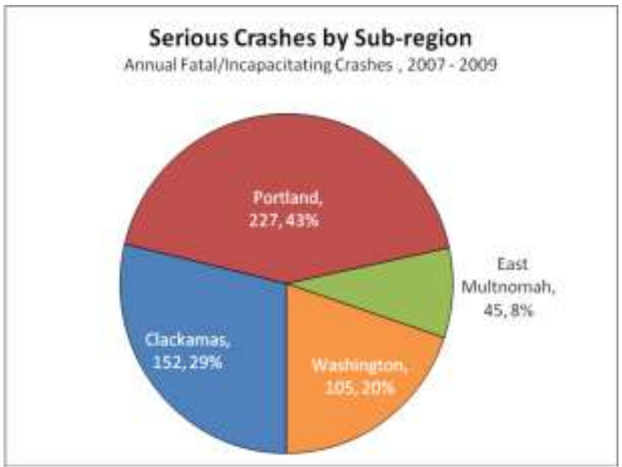
*estimated

The City of Portland, the Portland Metro region, and the State of Oregon all have fatality rates below the national average. The United Kingdom and European Union data are included for reference as international best practice.

By Sub-Region

Sub-Region	Annual Crashes	Fatal Crashes	Injury A Crashes	Injury B Crashes	Injury C Crashes	All Injury Crashes	Fatal/ Incapac.
Clackamas	2,627	6	146	221	715	1,082	152
Portland	9,286	27	200	998	2,596	3,794	227
East Multnomah	1,410	5	41	175	445	661	45
Washington	4,901	13	92	509	1,412	2,013	105
METRO	18,263	50	481	1,907	5,174	7,562	532

Figures 2-3 and 2-4



Sub-Region	Population	Annual VMT	All injury		Serious Crashes (Fatal/Incapacitating)	
			per 1M residents	per 100M VMT	per 1M residents	per 100M VMT
Clackamas	256,986	1,615,525,690	4,210	67.0	593	9.4
Portland	583,627	4,376,272,685	6,500	86.7	388	5.2
East Multnomah	136,130	654,385,044	4,856	101.0	333	6.9
Washington	499,259	2,669,124,479	4,030	75.4	210	3.9
METRO	1,481,118	9,308,676,259	5,106	81	359	5.7

With the highest population and VMT, Portland has the largest share of the region's serious crashes (Figure 2-3). Clackamas County has the highest rate of serious crashes per capita and per VMT. Washington County has the lowest rate of serious crashes per capita and per VMT.

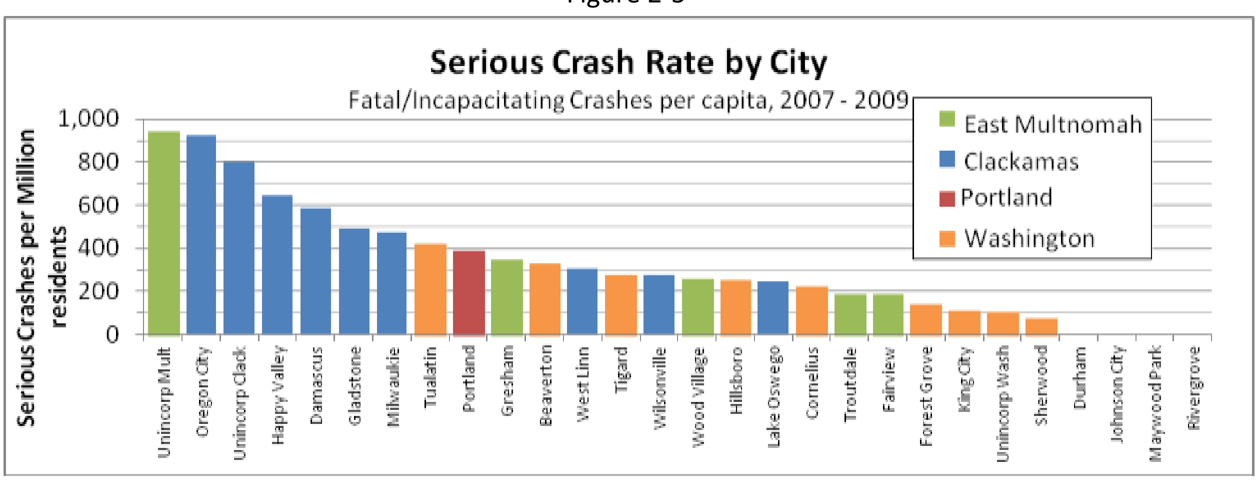
By City

City	Annual Crashes	Fatal Crashes	Injury A Crashes	Injury B Crashes	Injury C Crashes	All Injury Crashes	Fatal/ Incapac.
Beaverton	1,622	2.0	28	145	460	633	29.7
Cornelius	79	0.7	2	6	27	35	2.7
Damascus	102	0.3	6	13	26	45	6.0
Durham	10	0.0	0	1	4	4	0.0
Fairview	76	0.0	2	12	22	35	1.7
Forest Grove	108	0.0	3	16	29	48	3.0
Gladstone	88	0.0	6	5	24	35	5.7
Gresham	1,105	3.0	34	133	351	518	37.0
Happy Valley	129	0.7	8	12	33	54	9.0
Hillsboro	1,032	3.3	20	129	321	470	23.0
Johnson City	0.3	0.0	0	0	0	0	0.0
King City	4.3	0.0	0	0	0	0	0.3
Lake Oswego	261	0.0	9	15	71	95	9.0
Maywood Park	15	0.0	0	1	4	5	0.0
Milwaukie	174	0.7	9	16	43	68	9.7
Oregon City	461	1.0	29	38	125	193	30.0
Portland	9,286	26.7	200	998	2,596	3,794	226.7
Rivergrove	1.0	0.0	0	0	0	0	0.0
Sherwood	111	0.3	1	14	30	45	1.3
Tigard	742	1.7	12	68	209	288	13.3
Troutdale	127	0.3	3	16	37	56	3.0
Tualatin	349	1.0	10	37	102	149	11.0
West Linn	178	0.0	8	16	53	76	7.7
Wilsonville	165	0.3	5	15	47	67	5.3
Wood Village	64	0.0	1	9	24	34	1.0
Unincorp Clack	1,095	3.3	67	92	303	462	70.0
Unincorp Mult	73	1.7	4	11	16	31	5.7
Unincorp Wash	804	3.3	17	88	217	322	20.0
METRO	18,263	50.3	481	1,907	5,174	7,562	532

These two tables and the accompanying Figure 2-5 summarize crash data within the region by City and for the unincorporated sections of each of the three counties. Crash rates were determined per capita but not per VMT, as the VMT estimates for the smaller cities are not considered reliable enough for such an analysis.

County	Population	All injury per capita	Fatal/ Incapac. per capita
Beaverton	90,203	7,018	329
Cornelius	11,869	2,949	225
Damascus	10,211	4,407	588
Durham	1,306	3,318	0
Fairview	8,926	3,958	187
Forest Grove	21,094	2,276	142
Gladstone	11,529	3,007	492
Gresham	105,588	4,906	350
Happy Valley	13,906	3,859	647
Hillsboro	91,507	5,140	251
Johnson City	436	765	0
King City	3,090	108	108
Lake Oswego	36,586	2,597	246
Maywood Park	752	7,092	0
Milwaukie	20,560	3,324	470
Oregon City	32,476	5,933	924
Portland	583,627	6,500	388
Rivergrove	289	0	0
Sherwood	18,207	2,453	73
Tigard	48,058	6,000	277
Troutdale	15,800	3,565	190
Tualatin	26,102	5,708	421
West Linn	25,112	3,026	305
Wilsonville	19,509	3,417	273
Wood Village	3,878	8,681	258
Unincorp Clack	87,502	5,276	800
Unincorp Mult	6,018	5,151	942
Unincorp Wash	186,977	1,722	107
METRO	1,481,118	5,106	359

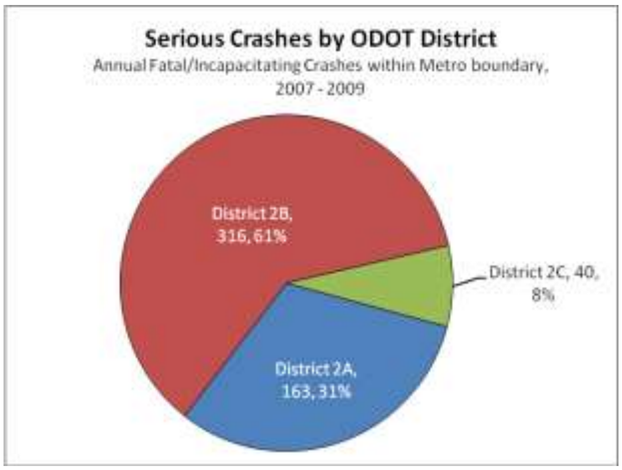
Figure 2-5

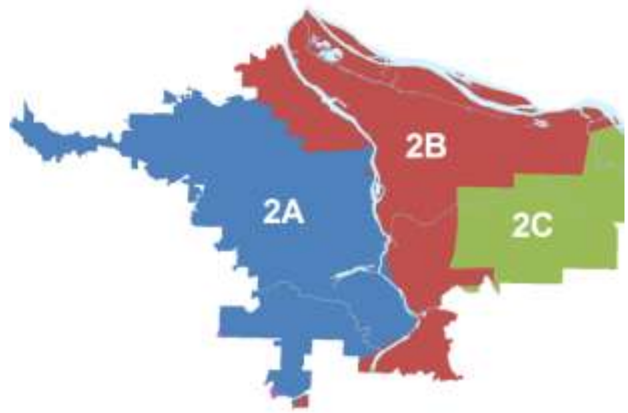


By ODOT District (within Metro Urban Growth Boundary)

District	Annual Crashes	Fatal Crashes	Injury A Crashes	Injury B Crashes	Injury C Crashes	All Injury Crashes	Fatal/ Incapac.
2A	6,906	16	146	722	1,952	2,820	163
2B	9,584	29	287	1,022	2,793	4,102	316
2C	898	5	36	110	259	405	40
METRO	17,388	50	469	1,854	5,005	7,327	519

Figures 2-6 and 2-7





District	Population (2010)	Annual VMT	All injury		Serious Crashes (Fatal/Incapacitating)	
			per capita	per VMT	per capita	per VMT
2A	679,704	4,236,063,970	4,149	67	239	3.8
2B	677,614	4,674,325,537	6,054	88	466	6.8
2C	123,800	398,286,752	3,269	102	326	10.1
METRO	1,481,118	9,308,676,259	4,947	79	350	5.6

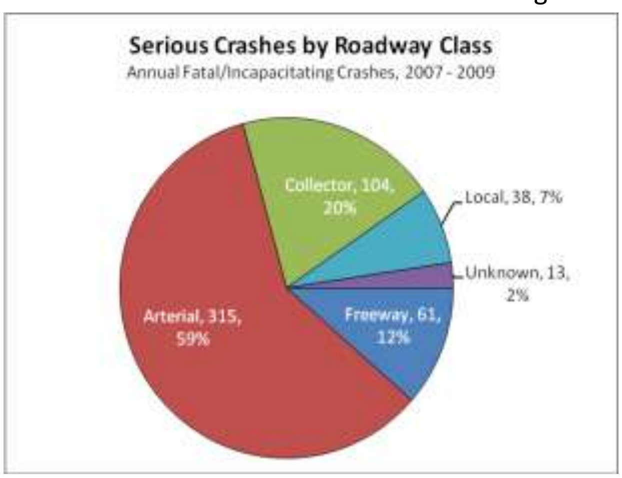
District 2B has the largest share of the region's serious crashes (Figure 2-6). With comparable population and VMT compared to District 2B, District 2A has a lower rate of serious crashes. District 2C has the lowest number but highest rates of serious crashes per capita and per VMT.

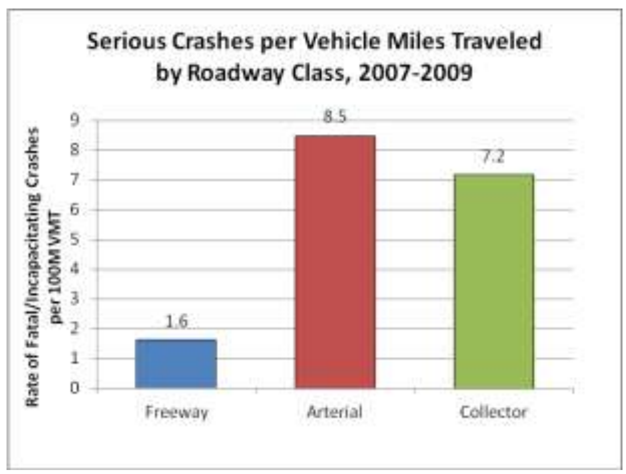
By Roadway Classification

	Annual Crashes	Fatal Crashes	Injury A Crashes	Injury B Crashes	Injury C Crashes	All Injury Crashes	Fatal/ Incapac.	Percent Fatal/ Incapac.
Freeway	2,800	6.3	55	262	854	1,171	61	2.2%
Arterial	9,845	30.7	285	1,038	3,003	4,326	315	3.2%
Collector	3,398	10.0	94	426	870	1,391	104	3.1%
Local	1,346	3.3	35	128	277	440	38	2.8%
Unknown	874	0.0	13	53	170	235	13	1.4%
METRO	18,263	50.3	481	1,907	5,174	7,562	532	2.9%

District	Annual VMT	All injury per VMT	Fatal/ Incapac. per VMT
Freeway	3,733,753,312	31.4	1.6
Arterial	3,716,028,247	116.4	8.5
Collector	1,453,638,411	95.7	7.2
Local	Not Available	--	--

Figures 2-8 and 2-9





A review of the distribution of the region's serious crashes by roadway classification reveals one of the most conclusive relationships in this study. Arterial roadways are the location of the majority of the serious crashes in the region (Figure 2-8). A similar relationship is evident for pedestrians and cyclists, as detailed in Sections 5 and 6. Freeways and their ramps are relatively safe, per mile travelled, compared to arterial and collector roadways (Figure 2-9).

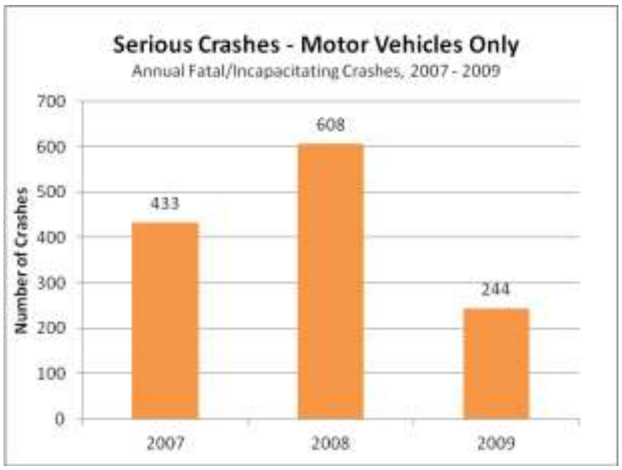
Figure 2-10 presents the functional classification of the region's roadways.

Figure 2-10

By Mode

	Pedestrians		Bicyclists		Autos Only	
	All injury crashes	Fatal/ Incapac.	All injury crashes	Fatal/ Incapac.	All injury crashes	Fatal/ Incapac.
2007	266	79	288	43	6,697	433
2008	291	55	370	43	6,804	608
2009	309	54	390	36	7,273	244
Total	866	188	1,048	122	20,774	1,285

Figures 2-11 and 2-12



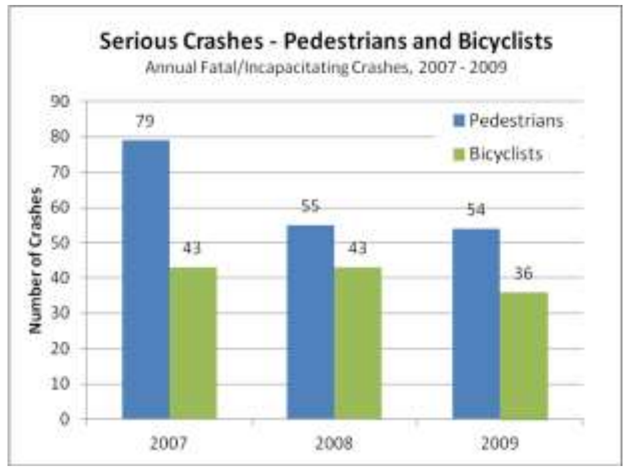


Figure 2-13

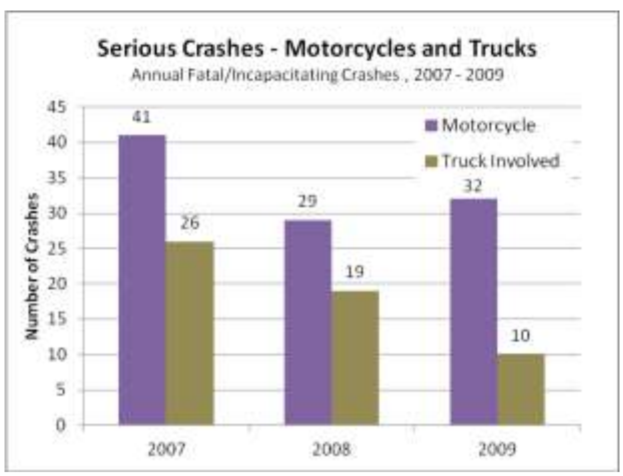


Figure 2-11 presents the annual number of serious crashes involving only motor vehicles (no pedestrians or cyclists). Figure 2-12 presents the annual number of serious crashes involving pedestrians and cyclists. Figure 2-13 presents the annual number of serious crashes involving motorcycles and large trucks.

By Month

Month	Annual crashes	All injury crashes	Fatal/ Incapac.
January	1,544	606	56.3
February	1,298	510	36.3
March	1,413	574	40.3
April	1,529	641	42.0
May	1,593	674	52.0
June	1,486	607	41.7
July	1,494	644	51.0
August	1,530	670	41.7
September	1,441	621	36.3
October	1,648	697	43.3
November	1,614	679	51.7
December	1,673	638	39.0

Figure 2-14

Figure 2-14 presents the annual average number of serious crashes by month. No clear trend is evident.

By Time of Day

Figure 2-15

Serious Crashes by Day of Week and Hour

Annual Fatal/Incapacitating Crashes, 2007 - 2009

Hour	Sun	Mon	Tue	Wed	Thu	Fri	Sat
12 AM	2.3	1.0	1.0	0.7	1.3	1.7	4.0
1 AM	2.0	1.0	1.3	0.3	2.0	0.7	4.0
2 AM	1.7	1.0	0.3	0.7	2.0	2.3	5.7
3 AM	1.7	0.0	0.0	0.3	0.0	1.0	1.0
4 AM	0.0	0.0	0.0	0.0	0.0	0.0	2.7
5 AM	1.3	1.7	1.3	0.3	0.7	1.3	0.0
6 AM	0.7	3.7	3.3	3.0	5.3	2.0	0.7
7 AM	1.7	3.3	3.7	3.3	5.0	3.7	1.3
8 AM	1.0	4.7	3.3	3.7	5.3	5.0	1.3
9 AM	0.7	2.3	4.7	1.3	1.3	3.7	2.7
10 AM	2.3	3.3	4.3	4.3	2.0	3.7	2.0
11 AM	2.3	4.0	3.7	4.0	2.7	4.7	4.3
12 PM	3.3	5.3	4.7	5.3	2.7	2.7	4.0
1 PM	3.7	2.3	3.7	3.7	4.7	4.0	7.0
2 PM	6.3	5.0	5.0	4.3	2.3	6.0	3.7
3 PM	3.7	7.0	5.3	7.0	5.3	3.7	4.7
4 PM	2.0	6.3	5.7	8.0	6.3	5.0	3.7
5 PM	5.0	11.0	9.3	7.7	7.7	9.0	7.7
6 PM	4.0	8.7	5.0	3.7	4.0	6.0	3.7
7 PM	3.3	4.0	2.3	2.7	5.3	4.7	5.3
8 PM	1.0	1.3	2.0	1.7	5.0	3.0	1.7
9 PM	2.3	3.0	2.0	3.0	3.0	3.3	2.3
10 PM	1.7	1.7	1.7	1.3	2.3	4.0	4.3
11 PM	1.7	2.0	2.0	1.7	2.3	3.7	2.0

Hour	Avg Wkday	Avg Wkend
12 AM	1.1	3.2
1 AM	1.1	3.0
2 AM	1.3	3.7
3 AM	0.3	1.3
4 AM	0.0	1.3
5 AM	1.1	0.7
6 AM	3.5	0.7
7 AM	3.8	1.5
8 AM	4.4	1.2
9 AM	2.7	1.7
10 AM	3.5	2.2
11 AM	3.8	3.3
12 PM	4.1	3.7
1 PM	3.7	5.3
2 PM	4.5	5.0
3 PM	5.7	4.2
4 PM	6.3	2.8
5 PM	8.9	6.3
6 PM	5.5	3.8
7 PM	3.8	4.3
8 PM	2.6	1.3
9 PM	2.9	2.3
10 PM	2.2	3.0
11 PM	2.3	1.8

	Sun	Mon	Tue	Wed	Thu	Fri	Sat
All Day	55.7	83.7	75.7	72.0	78.7	84.7	79.7

	Avg Wkday	Avg Wkend
All Day	78.9	67.7

Figure 2-15 presents the rate of serious crashes by day of the week and hour of the day using a "heat map" format. Red cells indicate the highest relative crash time periods; green indicate the lowest relative crash time periods. The average weekday and weekend day are summarized on the right side of the figure, while each day is summarized and compared at the bottom of the figure.

The weekday evening peak hours produce the highest number of serious crashes, with the 5:00 – 5:59 pm hour as the worst. Late Friday night/early Saturday morning shows an unexpectedly high rate of serious crashes.

By Weather

Weather	Annual crashes	All injury crashes	Fatal/ Incapac.
Cloudy/Clear	14,042	6,030	425
Rain/Fog	3,258	1,343	96
Sleet/Snow	416	120	7
Unknown	547	69	4
Total	18,263	7,562	532

The majority (80%) of serious crashes occurred in clear or cloudy conditions (Figure 2-16).

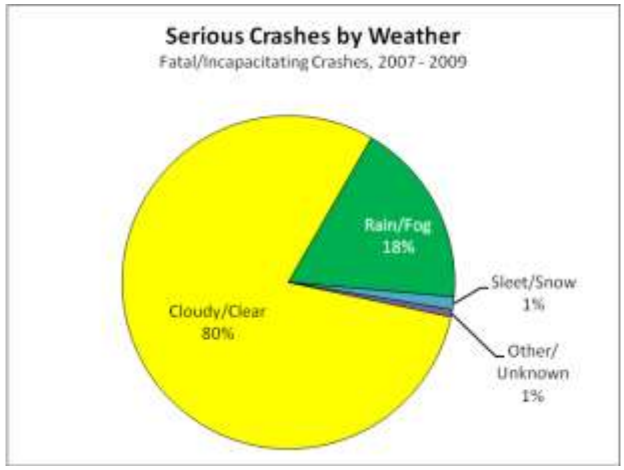


Figure 2-16

By Road Surface Condition

Road	Annual crashes	All injury crashes	Fatal/ Incapac.
Dry	13,027	5,609	387
Ice/Snow	609	177	12
Wet	4,093	1,714	130
Unknown	534	63	3
Total	18,263	7,562	532

The majority (73%) of serious crashes occurred in dry conditions (Figure 2-17).

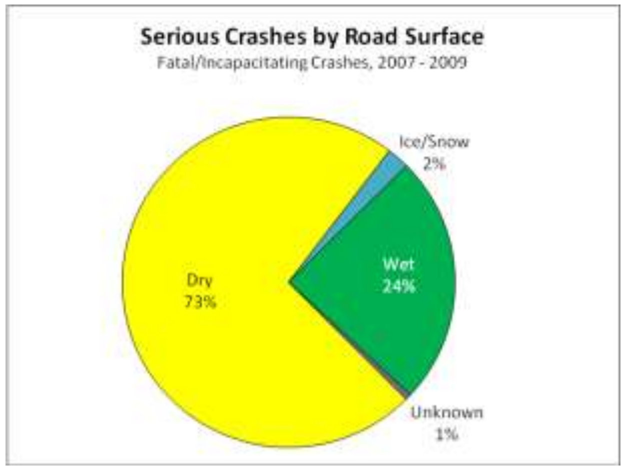


Figure 2-17

By Lighting

Lighting	Annual crashes	All injury crashes	Fatal/ Incapac.
Daylight	13,357	5,478	339
Dawn/Dusk	1,044	454	35
Night - Dark	668	255	29
Night - Lit	3,148	1,370	128
Unknown	45	7	1
Total	18,263	7,562	532

The majority (64%) of serious crashes occurred in daylight (Figure 2-18).

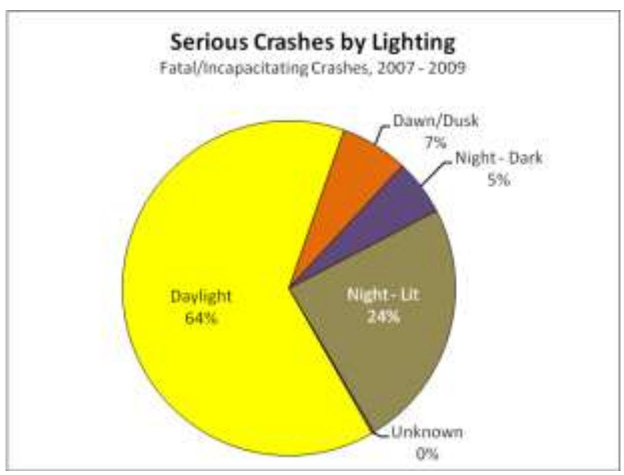
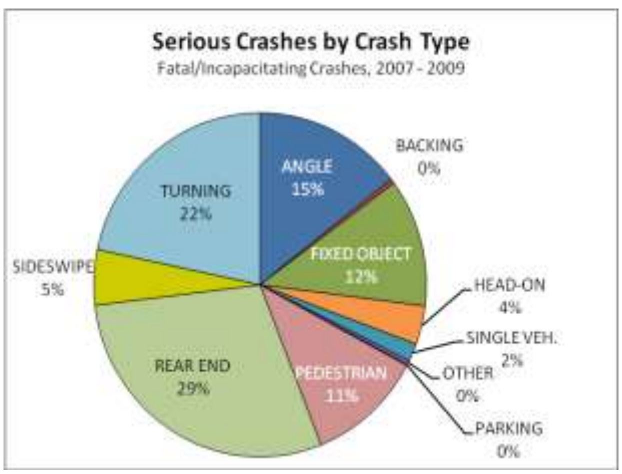


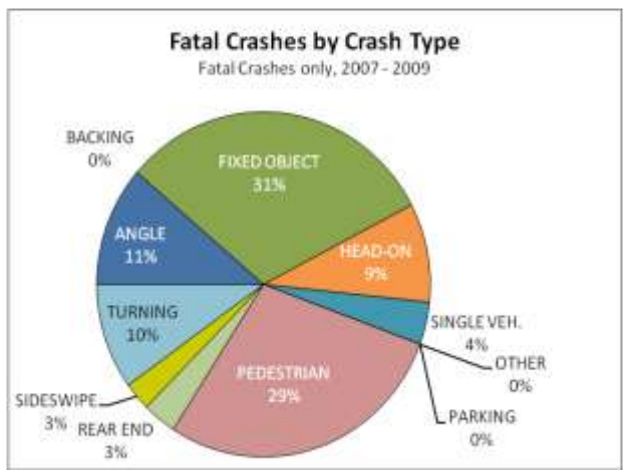
Figure 2-18

By Crash Type

Collision Type	Annual Crashes	Fatal Crashes	Injury A Crashes	Injury B Crashes	Injury C Crashes	All Injury Crashes	Fatal/ Incapac.
Angle	2,139	5.7	71	335	591	998	77
Backing	377	0.0	2	8	44	54	2
Fixed Object	1,181	15.7	48	194	218	460	64
Head-on	135	4.7	15	28	29	72	19
Single Vehicle	86	2.0	7	31	21	59	9
Other	61	0.0	2	9	9	21	2
Parking	89	0.0	1	2	11	14	1
Pedestrian	295	14.3	45	125	107	277	60
Rear End	7,813	1.7	153	507	2,847	3,507	155
Sideswipe	1,819	1.3	26	106	299	431	28
Turning	4,268	5.0	110	561	998	1,670	115
METRO	18,263	50.3	481	1,907	5,174	7,562	532

Figures 2-19 and 2-20





Figures 2-19 and 2-20 present serious crash types and fatal crash types. Fatal crashes are specifically broken out here because the distribution is substantially different. For the purpose of establishing crash type, bicycles are considered vehicles, and so there is no separate bicycle crash type.

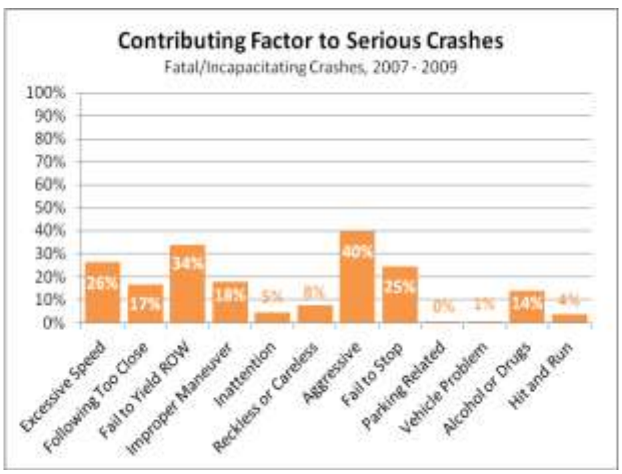
The most common serious crash types were Rear End and Turning.

The most common fatal crash types were Fixed Object and Pedestrian.

By Contributing Factor

Collision Type	Annual Crashes	Fatal Crashes	Injury A Crashes	Injury B Crashes	Injury C Crashes	All Injury Crashes	Fatal/ Incapac.
Excessive Speed	2,773	23	117	286	786	1,188	140
Following Too Close	6,202	0	89	353	2,278	2,720	89
Fail to Yield ROW	5,359	13	166	806	1,379	2,351	179
Improper Maneuver	4,011	12	82	301	763	1,146	94
Inattention	837	1	23	109	283	415	24
Reckless or Careless	539	4	38	126	159	323	41
Aggressive	8,151	23	188	588	2,775	3,551	211
Fail to Stop	6,918	1	130	426	2,503	3,060	131
Parking Related	123	0	2	4	17	23	2
Vehicle Problem	78	0	4	9	17	29	4
Alcohol or Drugs	600	29	45	120	149	315	74
Hit and Run	851	4	16	74	302	393	21
METRO	18,263	50	481	1,907	5,174	7,562	532

Figures 2-21 and 2-22



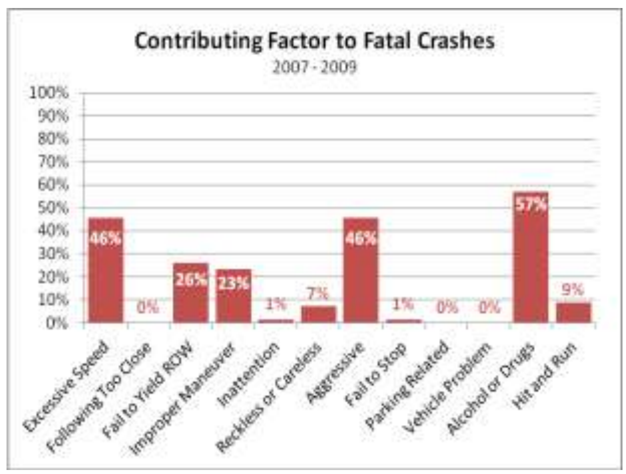


Figure 2-21 presents the the percentage of crashes of serious severity (fatal or injury A) with each contributing factor. Figure 2-22 presents the the percentage of fatal crashes with each contributing factor. Each crash may have several contributing factors.

Alcohol and Drugs, Excessive Speed, and Aggressive Driving are particularly common factors. Crashes involving Alcohol and Drugs have a much higher likelihood of being fatal than other crashes.

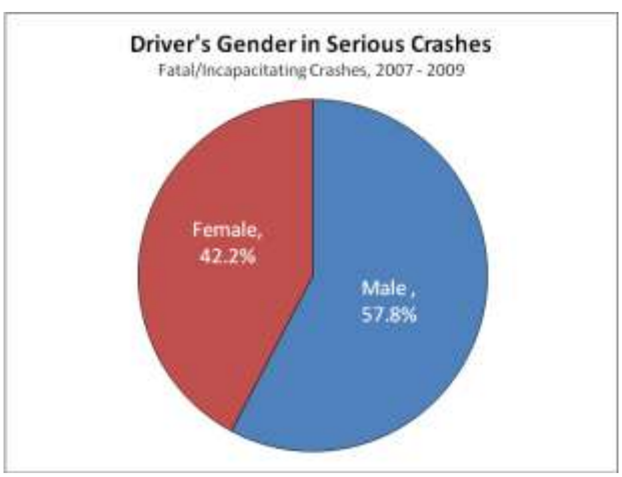
A detailed definition of each contributing factor is provided in Section 7.

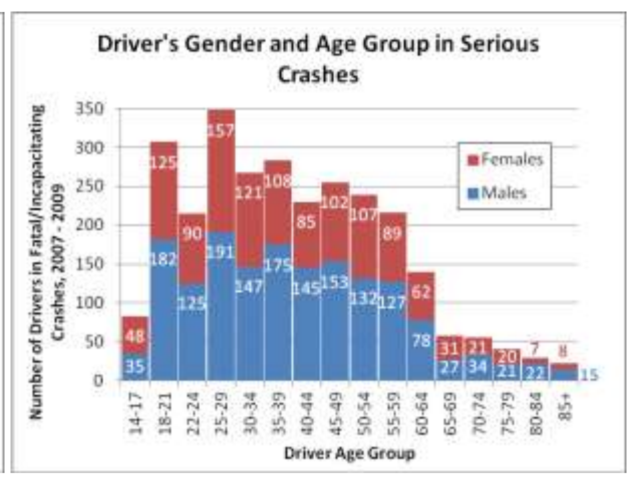
By Driver's Age and Gender

The age and gender of drivers involved in crashes, regardless of fault, are presented in the following table and Figures 2-23 and 2-24.

	Number of Male Drivers			Number of Female Drivers		
Males	All Crashes	Fatal/ Incapac.	Percent Fatal/ Incapac.	All Crashes	Fatal/ Incapac.	Percent Fatal/ Incapac.
14-17	1,742	35	2.0%	1,710	48	2.8%
18-21	5,518	182	3.3%	4,809	125	2.6%
22-24	3,924	125	3.2%	3,499	90	2.6%
25-29	6,556	191	2.9%	5,498	157	2.9%
30-34	5,742	147	2.6%	4,664	121	2.6%
35-39	5,517	175	3.2%	4,517	108	2.4%
40-44	5,199	145	2.8%	3,911	85	2.2%
45-49	5,376	153	2.8%	4,143	102	2.5%
50-54	4,889	132	2.7%	3,795	107	2.8%
55-59	4,339	127	2.9%	3,362	89	2.6%
60-64	3,090	78	2.5%	2,568	62	2.4%
65-69	1,763	27	1.5%	1,333	31	2.3%
70-74	1,120	34	3.0%	927	21	2.3%
75-79	807	21	2.6%	676	20	3.0%
80-84	641	22	3.4%	531	7	1.3%
85+	392	15	3.8%	316	8	2.5%
Unknown	7,650	26	0.3%	4,744	15	0.3%
Total	**64,265**	**1,635**	**2.5%**	**51,003**	**1,196**	**2.3%**

Figures 2-23 and 2-24





Seat Belt Use

The reported use of seat belts is shown in the following tables, for all crashes, for serious crashes only, and for non-serious crashes.

Seat Belt Use (all crashes)					
	Seat Belt Use	No Seat Belt	Unknown	% Seat Belt Use	% No Seat Belt
Males	43,678	483	25,472	98.9%	1.1%
Females	41,229	269	17,150	99.4%	0.6%
Unknown	80	8	3,394	90.9%	9.1%
Total	84,987	760	46,016	99.1%	0.9%

Seat Belt Use (Serious crashes)					
	Seat Belt Use	No Seat Belt	Unknown	% Seat Belt Use	% No Seat Belt
Males	1,561	52	314	96.8%	3.2%
Females	1,456	28	197	98.1%	1.9%
Unknown	3	0	43	100%	0.0%
Total	3,020	80	554	97.4%	2.6%

Seat Belt Use (Injury B, C, and PDO crashes)					
	Seat Belt Use	No Seat Belt	Unknown	% Seat Belt Use	% No Seat Belt
Males	42,117	431	25,158	99.0%	1.0%
Females	39,773	241	16,953	99.4%	0.6%
Unknown	77	8	3,351	90.6%	9.4%
Total	81,967	680	45,462	99.2%	0.8%

Seat belt use in the region is nearly 100%.

Males were 69% more likely than females to be reported without a seat belt.

Occupants without seat belts were 3 times as likely to be seriously injured or killed as occupants wearing seat belts.

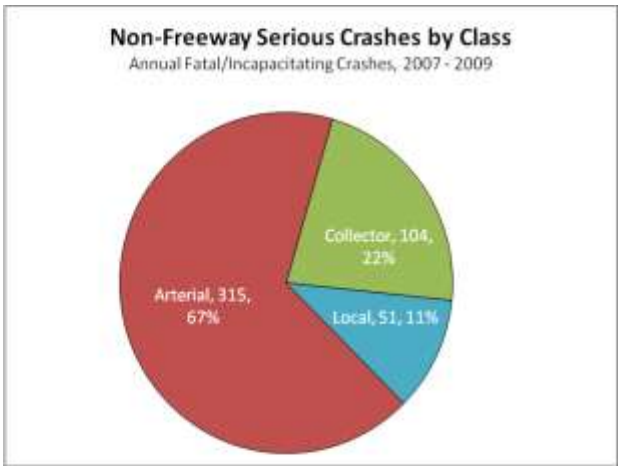
Section 3 – Roadway Characteristics of Non-Freeway Crashes

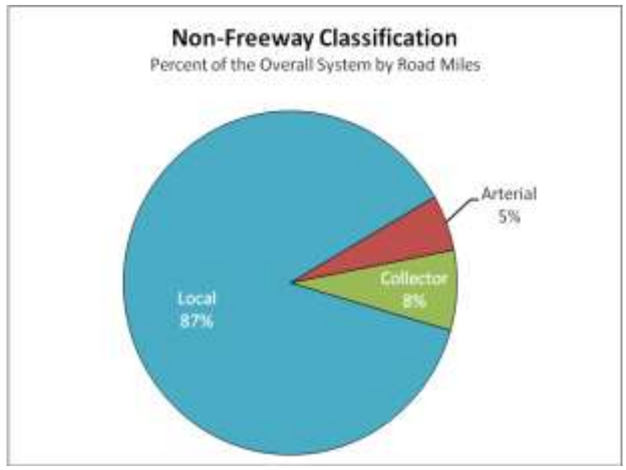
By Roadway Classification

	Total Length	Annual VMT	Annual crashes	All injury crashes	Serious Crashes (Fatal/Incapac.)
Arterial	626.7	3,716,028,247	9,848	4,328	315
Collector	900.0	1,453,638,411	3,400	1,392	104
Local	10,394.2	--	2,215	672	51
Total	11,920.9	5,169,666,658*	15,463	6,392	471

* VMT for Arterials and Collectors only

Figures 3-1 and 3-2



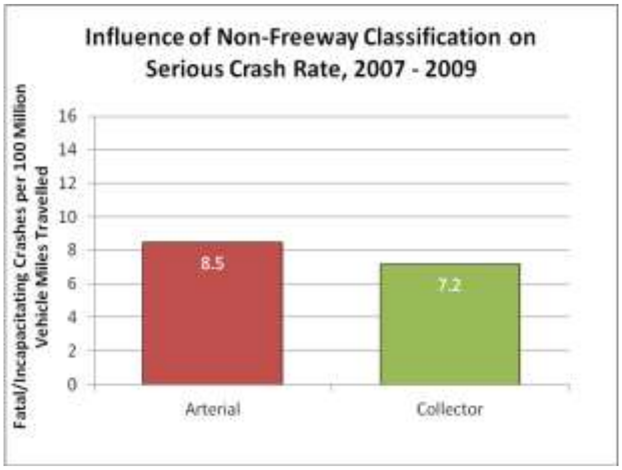


	% crashes resulting in		Per mile		Per VMT	
	Injury	Fatal/ Incapac.	Injury crashes	Fatal/ Incapac.	Injury crashes	Fatal/ Incapac.
Arterial	44%	3.2%	6.91	0.503	116.5	8.5
Collector	41%	3.1%	1.55	0.116	95.8	7.2
Local	30%	2.3%	0.06	0.005	--	--
METRO	41%	3.0%	--	--	--	--

A review of the distribution of non-freeway serious crashes by roadway classification reveals one of the most conclusive relationships in this report. Arterial roadways are the location of the majority of the serious crashes in the region. Despite making up only 5% of the region's non-freeway road miles, they constitute 67% of the serious crashes (Figures 3-1 and 3-2). A similar relationship is evident for pedestrians and cyclists, as detailed in Sections 5 and 6. This is likely due to high traffic volumes, high travel speeds, and the general lack of accommodation of people crossing on arterials throughout the region.

Arterials also have the highest crash rate per traffic volume (Figure 3-3). Figure 3-4 presents the functional classification of the region's roadways.

Figures 3-3 and 3-4

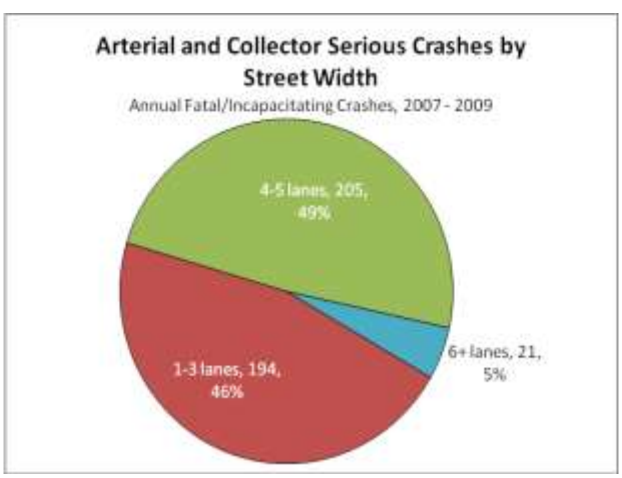


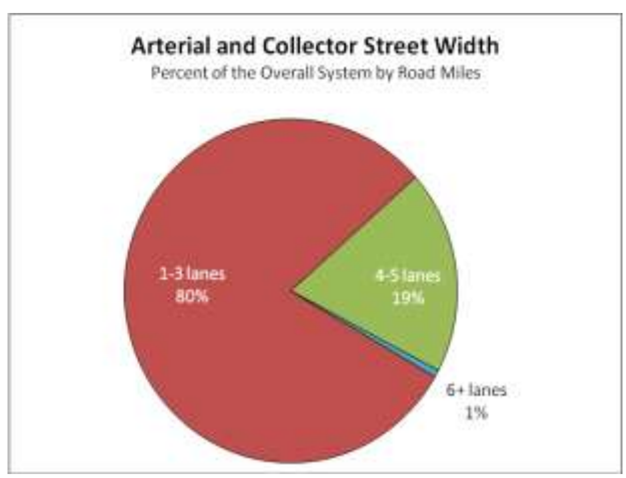
By Number of Lanes

The following tables and Figures 3-5 and 3-6 summarize crashes by number of lanes for arterial and collector roadways.

	Total Length	Annual VMT	Annual crashes	All injury crashes	Fatal/Incapac.
1 – 3 Lanes	1,224	2,663,319,790	5,951	2,495	194
4 – 5 Lanes	293	2,376,367,869	6,683	2,966	205
6+ Lanes	10	130,075,443	609	256	21

Figures 3-5 and 3-6



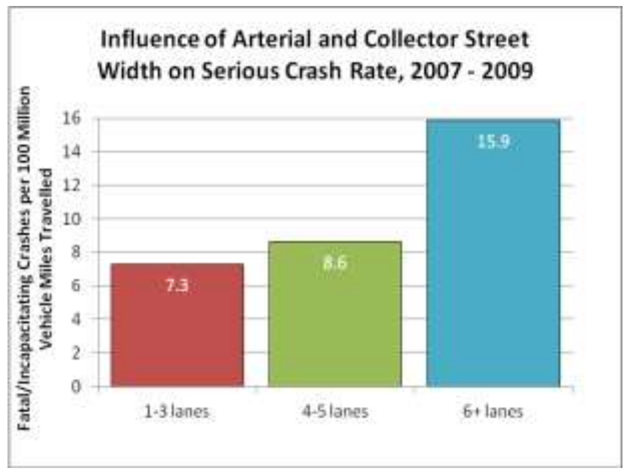


	% crashes resulting in		Per mile		Per VMT	
	Injury	Fatal/ Incapac.	Injury crashes	Fatal/ Incapac.	Injury crashes	Fatal/ Incapac.
1 – 3 Lanes	42%	7.8%	2.04	0.16	93.7	7.3
4 – 5 Lanes	44%	6.9%	10.12	0.70	124.8	8.6
6+ Lanes	42%	8.1%	25.44	2.05	196.8	15.9

Figure 3-7 presents the crash rate per traffic volume, and Figure 3-8 presents the number of lanes for arterials and collectors in the region.

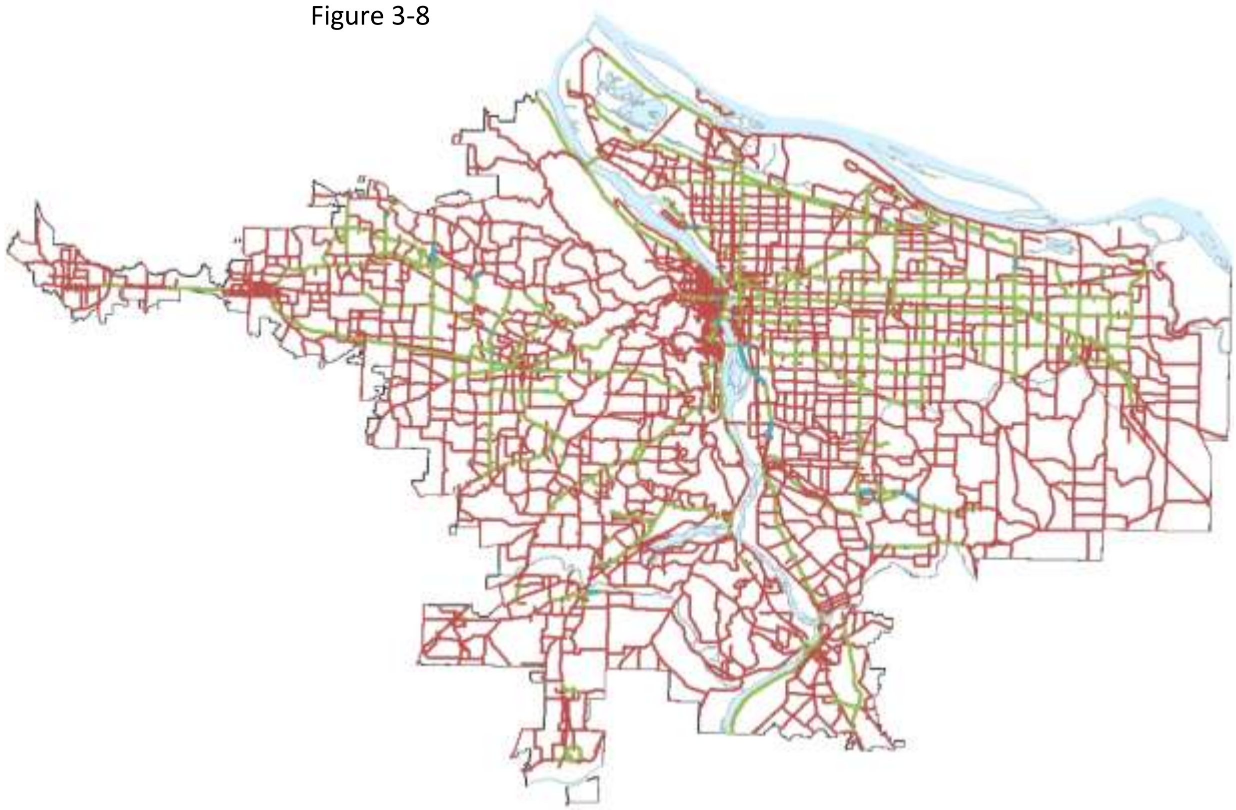
The influence of street width is consistent with the influence of roadway classification. Wider roadways are the location of a disproportionate number of serious crashes in relation to both their share of the overall system (Figures 3-4 and 3-5) and the vehicle-miles travelled they serve (Figure 3-6). The crash rate increases dramatically for roadways with 6 or more lanes.

Figure 3-7



Similar patterns are documented in AASHTO's Highway Safety Manual (2010), Chapter 12.

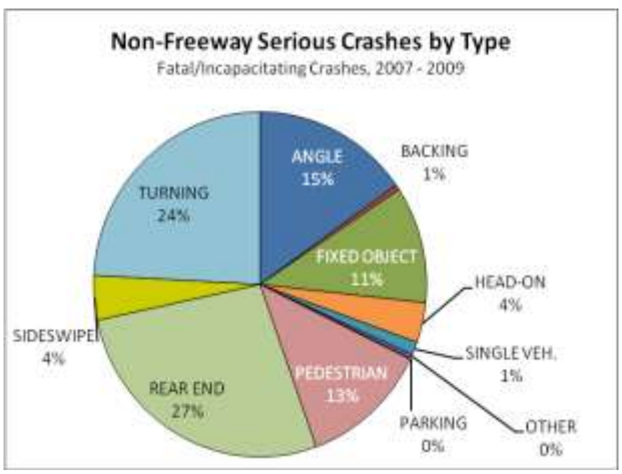
Figure 3-8

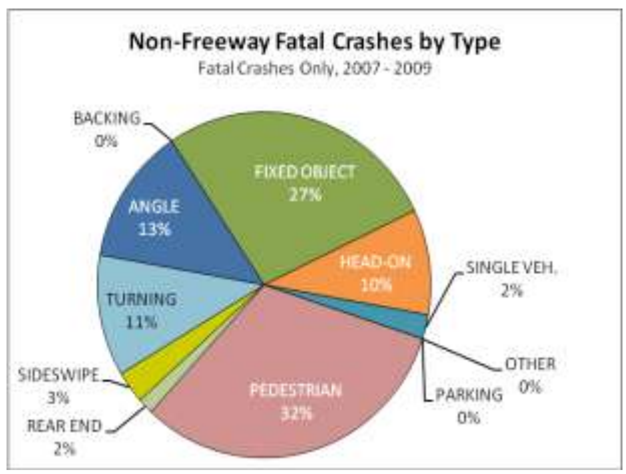


By Crash Type

Collision Type	Annual Crashes	Fatal Crashes	Injury A Crashes	Injury B Crashes	Injury C Crashes	All Injury Crashes	Fatal/ Incapac.
Angle	2,029	5.7	66	316	553	935	72
Backing	370	0.0	2	7	43	52	2
Fixed Object	936	12.0	40	146	170	355	52
Head-on	127	4.3	13	26	28	67	18
Single Vehicle	63	1.0	5	24	17	46	6
Other	43	0.0	2	8	7	16	2
Parking	88	0.0	1	2	11	14	1
Pedestrian	290	14.0	44	124	104	273	58
Rear End	6,075	0.7	127	374	2,223	2,724	128
Sideswipe	1,409	1.3	18	80	217	316	20
Turning	4,033	5.0	109	538	946	1,593	114
Total	15,463	44.0	427	1,645	4,320	6,392	471

Figure 3-9 and 3-10





Figures 3-9 and 3-10 present non-freeway serious crash types and non-freeway fatal crash types. Fatal crashes are specifically broken out here because the distribution is substantially different. For the purpose of establishing crash type, bicycles are considered vehicles, and so there is no separate bicycle crash type.

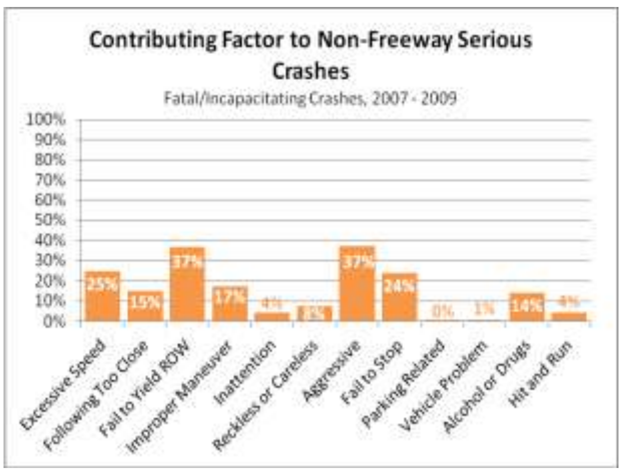
The most common serious crash types were Rear End and Turning.

The most common fatal crash types were Pedestrian and Fixed Object.

By Contributing Factor

Factor	Annual Crashes	Fatal Crashes	Injury A Crashes	Injury B Crashes	Injury C Crashes	All Injury Crashes	Fatal/ Incapac.
Excessive Speed	2,080	18	98	206	569	873	116
Following Too Close	4,781	0	71	257	1,764	2,092	71
Fail to Yield ROW	5,107	12	161	771	1,311	2,244	174
Improper Maneuver	3,396	10	71	249	631	951	80
Inattention	691	0	19	94	235	348	19
Reckless or Careless	460	3	32	107	138	277	35
Aggressive	6,349	18	157	435	2,161	2,753	175
Fail to Stop	5,589	0	111	332	2,031	2,474	112
Parking Related	119	0	2	3	16	22	2
Vehicle Problem	53	0	3	7	12	22	3
Alcohol or Drugs	538	26	39	106	133	278	65
Hit and Run	709	4	15	59	250	324	19
METRO	15,463	44	427	1,645	4,320	6,392	471

Figures 3-11 and 3-12



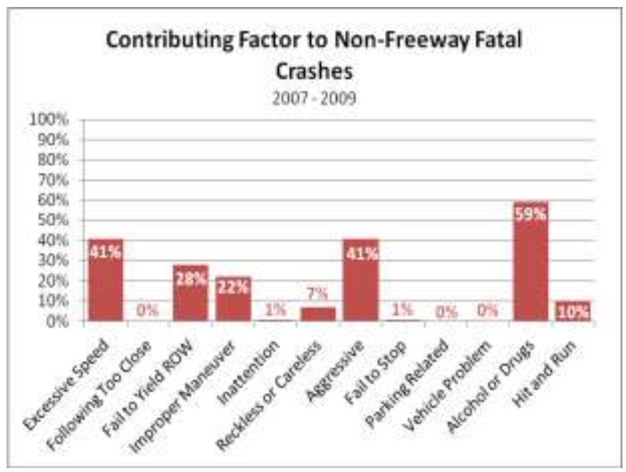


Figure 3-11 and 3-12 present the proportion of non-freeway crashes by contributing factor for serious and fatal crashes, respectively. Aggressive Driving, Speed, and Alcohol or Drugs are the most common factors.

By Volume-to-Capacity Ratio

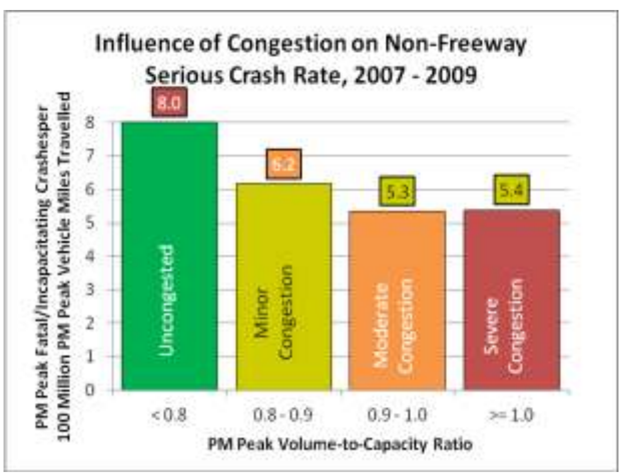
The combination of traffic data available from the region's travel demand model and crash data allowed for a comparison of traffic congestion with safety.

An analysis of serious crash rates compared to congestion levels for non-freeway roadways was performed. The analysis included all roadways in the regional travel demand model, including all arterials and collectors, as well as certain local streets serving a collector function. The intent was to establish the relationship between congestion and safety.

PM peak 3-hour Volume-to-Capacity ratios as determined by the travel demand model were compared to the same 3-hours of weekday crash data. The results are shown in the table and Figures 3-13. Figure 3-14 presents the Volume-to-Capacity ratios for the region's non-freeway roadways.

		PM Peak			Per Mile		Per VMT	
PM Peak V/C Range	Total Length (miles)	VMT	All injury crashes	Fatal/ Incapac.	All injury crashes	Fatal/ Incapac.	All injury crashes	Fatal/ Incapac.
< 0.8	1,345.4	1,084,012,637	1,272	86.7	0.95	0.06	117.4	8.0
0.8 - 0.9	91.0	151,691,335	221	9.3	2.42	0.10	145.5	6.2
0.9 - 1.0	45.1	87,440,817	88	4.7	1.94	0.10	100.3	5.3
≥ 1.0	45.1	105,359,218	90	5.7	2.00	0.13	85.4	5.4

Figures 3-13 and 3-14



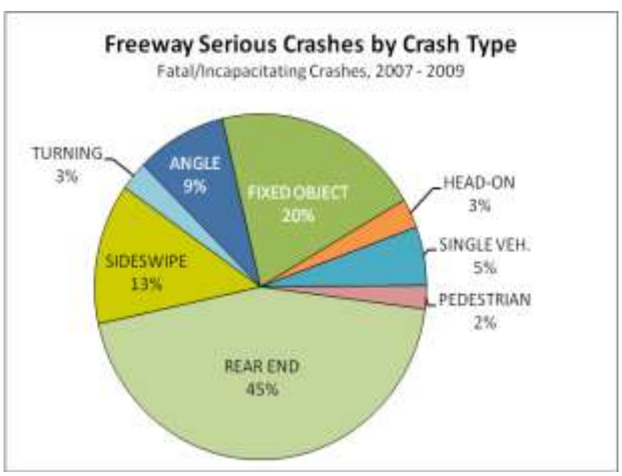
The serious crash rate per vehicle-mile travelled is highest for uncongested non-freeway roadways. Non-freeway roadways with higher levels of congestion exhibit lower crash rates.

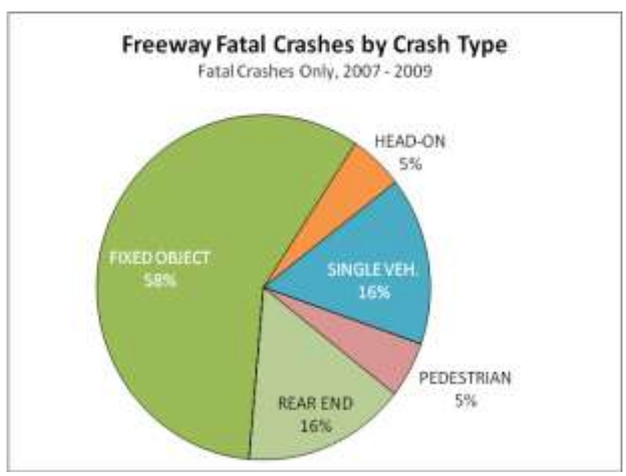
Section 4 – Roadway Characteristics of Freeway Crashes

By Crash Type

Collision Type	Annual Crashes	Fatal Crashes	Injury A Crashes	Injury B Crashes	Injury C Crashes	All Injury Crashes	Fatal/ Incapac.
Angle	110	0.0	5	19	38	62	5
Backing	8	0.0	0	1	1	2	0
Fixed Object	245	3.7	9	49	48	105	12
Head-on	8	0.3	1	2	1	5	2
Single Vehicle	23	1.0	2	7	3	13	3
Other	17	0.0	0	2	2	4	0
Parking	0	0.0	0	0	0	0	0
Pedestrian	5	0.3	1	1	3	4	1
Rear End	1,738	1.0	26	133	624	783	27
Sideswipe	410	0.0	8	26	81	115	8
Turning	236	0.0	2	23	52	76	2
TOTAL	2,800	6.3	55	262	854	1,171	61
Total – Freeway Mainline	2,008	4.0	40	185	624	848	44
Total – Freeway Ramps	792	2.3	15	77	230	322	17

Figure 4-1 and 4-2





Figures 4-1 and 4-2 present freeway serious crash types and freeway fatal crash types. Fatal crashes are specifically broken out here because the distribution is substantially different.

The most common serious crash types were Rear End crashes, constituting 45% of serious crashes.

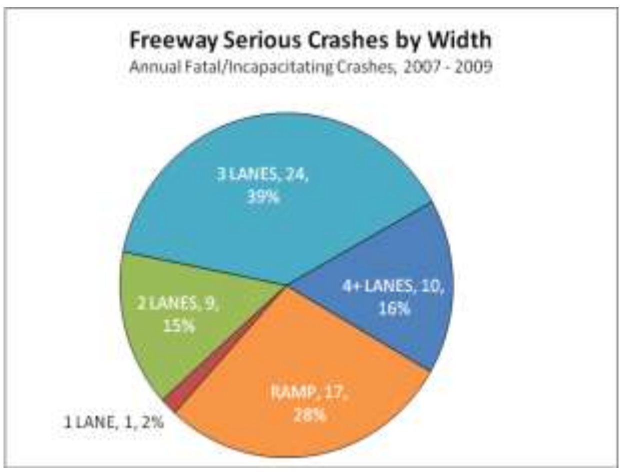
The most common fatal crash types were Fixed Object crashes, constituting 58% of fatal crashes.

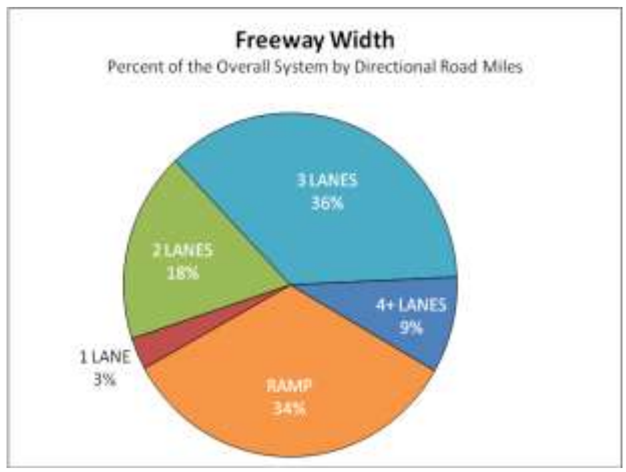
By Number of Lanes

Number of lanes (in one direction)	Total Length	Annual VMT	Annual crashes	All injury crashes	Fatal/Incapac.
Freeway ramp	92.9	336,224,295	792	322	17
1 Lanes	8.3	61,535,839	26	11	1
2 Lanes	49.6	661,971,141	342	148	9
3 Lanes	100.6	2,051,230,361	1,184	496	24
4+ Lanes	25.1	622,791,676	454	192	10
ALL FREEWAYS	276.5	3,733,753,312	2,800	1,171	61

Figures 4-3 and 4-4 present the distribution of freeway crashes by number of lanes. They also present the proportion of freeway crashes that occur on ramps.

Figure 4-3 and 4-4





Number of lanes (in one direction)	% crashes resulting in		Per mile		Per VMT	
	Injury	Fatal/ Incapac.	Injury crashes	Fatal/ Incapac.	Injury crashes	Fatal/ Incapac.
Freeway ramp	41%	2.2%	3.5	0.19	95.9	5.16
1 Lanes	43%	3.8%	1.4	0.12	18.4	1.63
2 Lanes	43%	2.6%	3.0	0.18	22.4	1.36
3 Lanes	42%	2.0%	4.9	0.24	24.2	1.15
4+ Lanes	42%	2.2%	7.7	0.40	30.9	1.61
ALL FREEWAYS	42%	2.2%	4.2	0.22	31.4	1.63

The influence of freeway width is not as pronounced as for non-freeway roadways. Freeways with three directional lanes (including auxiliary lanes) exhibit the lowest crash rates, while the rate increases for freeways with more or fewer lanes (Figure 4-5). Figure 4-6 presents the number of lanes for the region's freeways. Ramps exhibit a higher rate per mile travelled, while still representing a relatively small proportion (28%) of all serious freeway crashes (Figure 4-3).

Figure 4-5

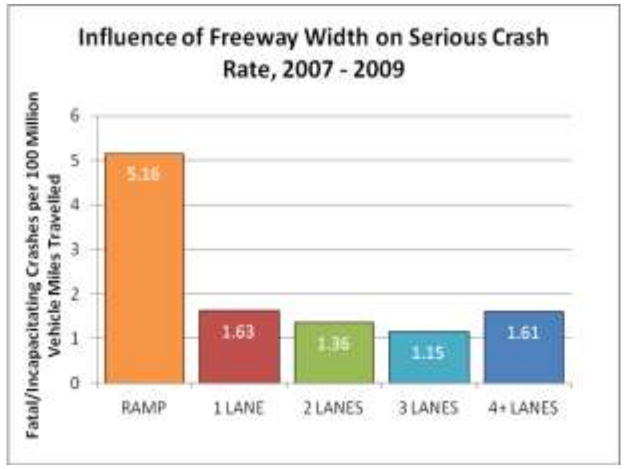
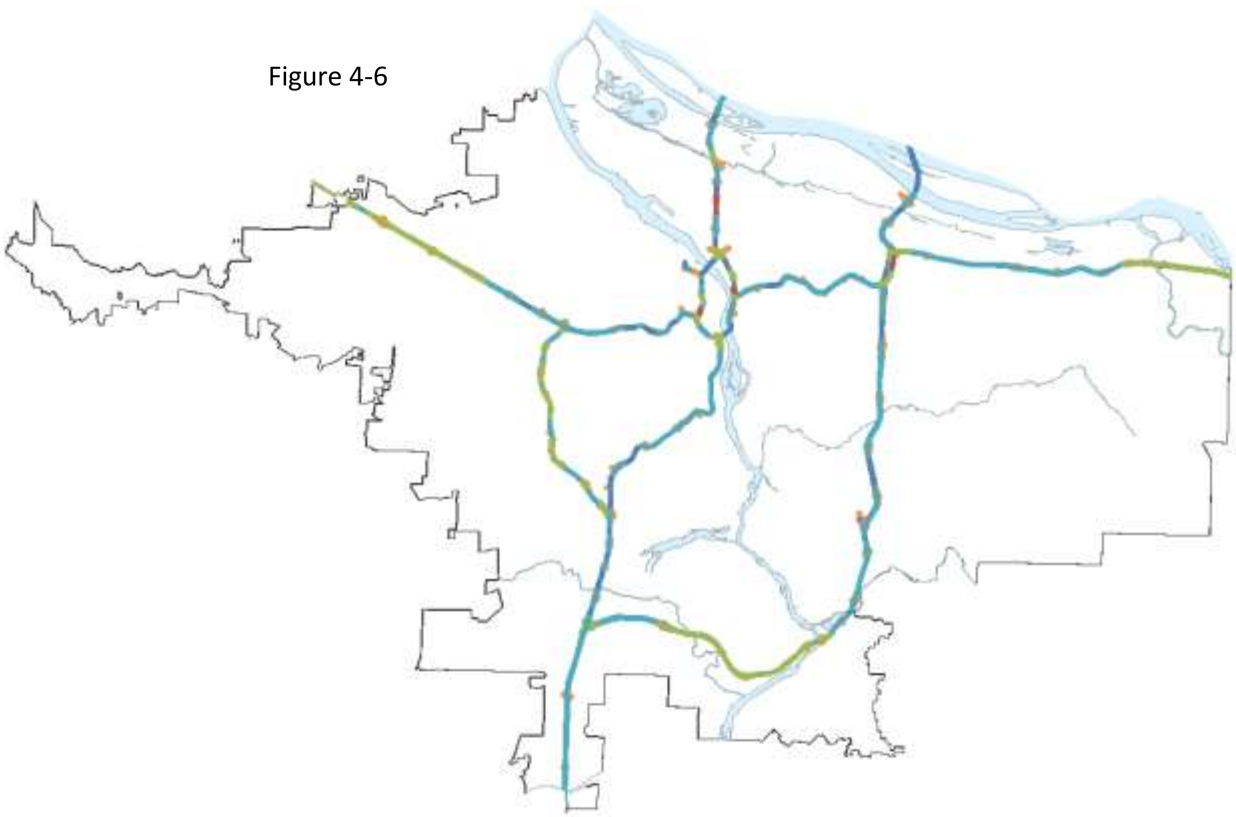


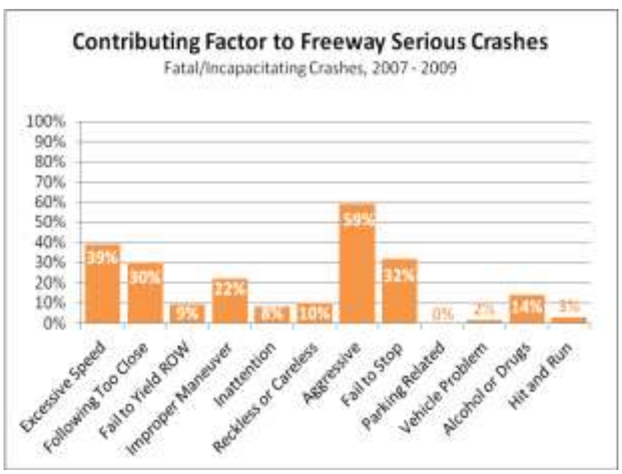
Figure 4-6



By Contributing Factor

Factor	Annual Crashes	Fatal Crashes	Injury A Crashes	Injury B Crashes	Injury C Crashes	All Injury Crashes	Fatal/ Incapac.
Excessive Speed	693	5	19	80	217	315	24
Following Too Close	1,421	0	18	96	514	628	18
Fail to Yield ROW	252	1	5	35	68	108	6
Improper Maneuver	615	2	11	52	132	195	13
Inattention	147	0	5	15	48	68	5
Reckless or Careless	78	1	5	19	22	46	6
Aggressive	1,803	5	31	152	614	798	36
Fail to Stop	1,329	0	19	95	473	586	19
Parking Related	4	0	0	0	1	1	0
Vehicle Problem	25	0	1	2	5	8	1
Alcohol or Drugs	62	3	6	14	16	37	9
Hit and Run	141	0	2	15	52	69	2
METRO	2,800	6	55	262	854	1,171	61

Figures 4-7 and 4-8



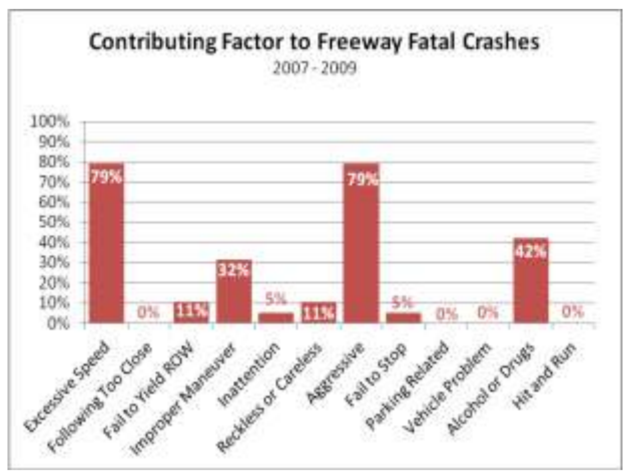


Figure 4-7 and 4-8 present the proportion of freeway crashes by contributing factor for serious and fatal crashes, respectively. Aggressive Driving and Speed are the most common factors.

By Volume-to-Capacity Ratio

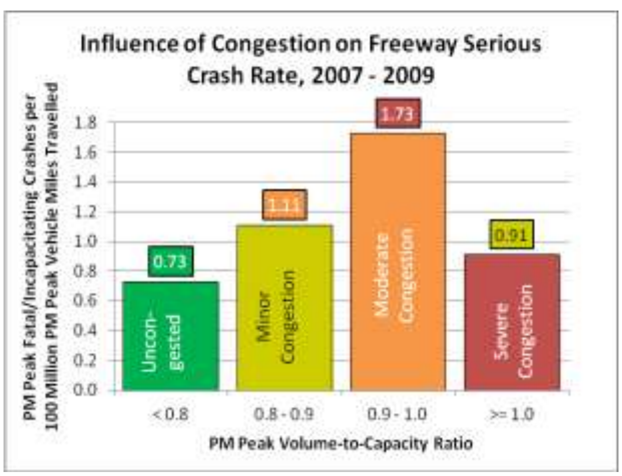
The combination of traffic data available from the region's travel demand model and crash data allowed for a comparison of traffic congestion with safety.

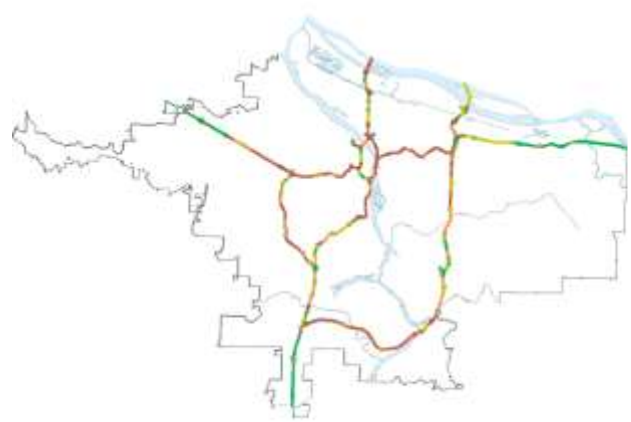
An analysis of serious crash rates compared to congestion levels for freeways was performed. The intent was to establish the relationship between congestion and safety.

PM peak 3-hour Volume-to-Capacity ratios as determined by the travel demand model were compared to the same 3-hours of weekday crash data. The results are shown in the table and Figures 4-9. Figure 4-10 presents the Volume-to-Capacity ratios for the region's freeways, including ramps.

PM Peak V/C Range	Total Length (miles)	PM Peak			Per Mile		Per VMT	
		VMT	All injury crashes	Fatal/ Incapac.	All injury crashes	Fatal/ Incapac.	All injury crashes	Fatal/ Incapac.
< 0.8	83.9	273,835,882	104	2.0	1.24	0.024	38.1	0.73
0.8 - 0.9	36.7	180,137,602	47	2.0	1.28	0.055	26.1	1.11
0.9 - 1.0	36.6	192,960,834	94	3.3	2.57	0.091	48.9	1.73
≥ 1.0	26.4	146,182,584	57	1.3	2.17	0.051	39.2	0.91

Figures 4-9 and 4-10





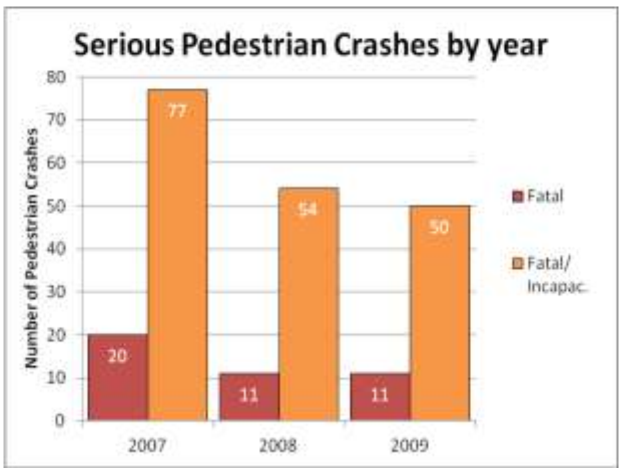
The serious crash rate per vehicle-mile travelled on freeways increases with congestion up to a point, then drops with severe congestion. The increase with increasing congestion may result from traffic at free-flow speed encountering traffic stopped or slowed for congestion. The drop at high congestion levels may be due to the low speeds and accompanying low risk associated with severe congestion.

Section 5 – Pedestrians (Non-Freeway Crashes)

By Year

Year	Fatal Crashes (Fatalities)	Injury A Crashes	Injury B Crashes	Injury C Crashes	All Injury Crashes	Fatal/ Incapac.
2007	20 (20)	57	115	88	260	77
2008	11 (11)	43	119	125	287	54
2009	11 (11)	39	147	114	300	50
METRO	42 (42)	139	381	327	847	181

Figure 5-1



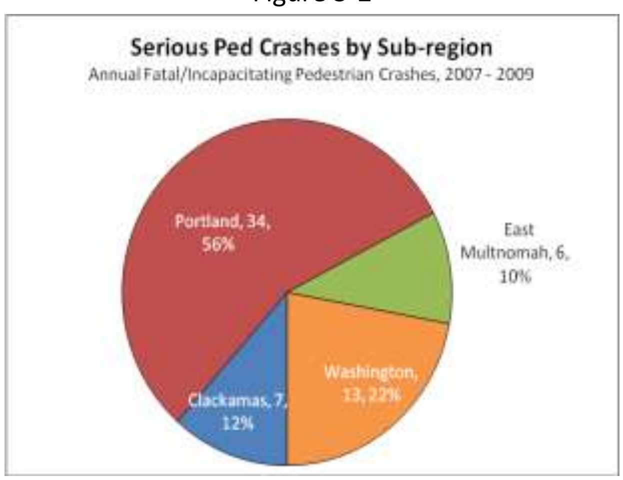
As presented in Figure 5-1, serious and fatal pedestrian crashes declined over the 3-year period.

By Sub-Region

County	Fatal crashes	Injury A crashes	Injury B crashes	Injury C crashes	All Injury crashes	Fatal/ Incapac.
Clackamas	1.7	5.3	9.0	16.7	31.0	7.0
Portland	7.3	26.3	80.7	61.3	168.3	33.7
East Multnomah	1.0	5.3	11.0	12.0	28.3	6.3
Washington	3.7	9.7	26.7	18.7	55.0	13.3
METRO	14.0	46.3	127.0	109.0	282.3	60.3

County	Population	Total VMT	All injury		Serious Crashes (Fatal/Incapacitating)	
			per capita	per VMT	per capita	per VMT
Clackamas	256,986	1,102,387,348	120.6	2.81	27.2	0.63
Portland	583,627	2,456,278,457	288.4	6.85	57.7	1.37
East Multnomah	136,130	491,944,454	208.1	5.76	46.5	1.29
Washington	499,259	1,811,815,622	110.2	3.04	26.7	0.74
METRO	1,481,118	5,854,310,275	190.6	4.82	40.7	1.03

Figure 5-2



With the highest population, transit usage, VMT, and likely the largest number of pedestrians, Portland has 56% of the region's serious pedestrian crashes (Figure 5-2). Portland also has the highest rate of serious pedestrian crashes per capita and per VMT. East Multnomah County also has high rates of serious pedestrian crashes per capita and per VMT. Clackamas County and Washington County have relatively low rates of serious pedestrian crashes, which is likely largely due to fewer people walking.

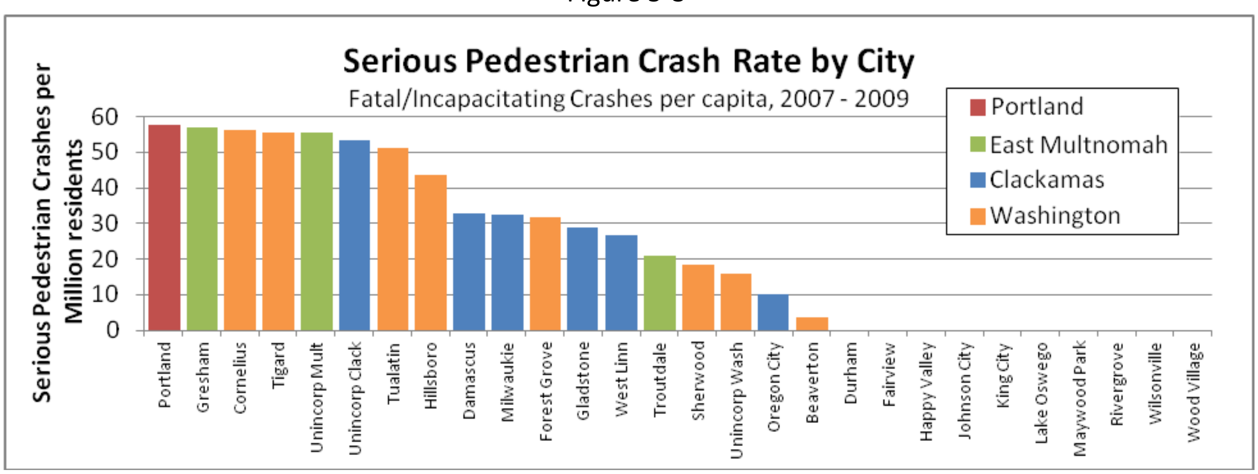
By City

City	Fatal crashes	Injury A crashes	Injury B crashes	Injury C crashes	All Injury crashes	Fatal/ Incapac.
Beaverton	0.0	0.3	3.3	5.3	9.0	0.3
Cornelius	0.7	0.0	1.0	1.0	2.0	0.7
Durham	0.0	0.3	0.0	0.3	0.7	0.3
Damascus	0.0	0.0	0.0	0.3	0.3	0.0
Fairview	0.0	0.0	0.3	0.7	1.0	0.0
Forest Grove	0.0	0.7	1.0	1.0	2.7	0.7
Gladstone	0.0	0.3	0.0	1.0	1.3	0.3
Gresham	1.0	5.0	9.7	10.0	24.7	6.0
Happy Valley	0.0	0.0	0.3	1.3	1.7	0.0
Hillsboro	0.7	3.3	10.0	4.7	18.0	4.0
Johnson City	0.0	0.0	0.0	0.0	0.0	0.0
King City	0.0	0.0	0.0	0.0	0.0	0.0
Lake Oswego	0.0	0.0	2.7	2.3	5.0	0.0
Maywood Park	0.0	0.0	0.0	0.0	0.0	0.0
Milwaukie	0.3	0.3	1.0	1.7	3.0	0.7
Oregon City	0.0	0.3	1.3	1.3	3.0	0.3
Portland	7.3	26.3	80.7	61.3	168.3	33.7
Rivergrove	0.0	0.0	0.0	0.0	0.0	0.0
Sherwood	0.0	0.3	0.7	0.0	1.0	0.3
Tigard	1.0	1.7	2.3	3.7	7.7	2.7
Troutdale	0.0	0.3	1.0	1.3	2.7	0.3
Tualatin	0.0	1.3	1.7	0.7	3.7	1.3
West Linn	0.0	0.7	0.3	1.0	2.0	0.7
Wilsonville	0.0	0.0	0.7	2.0	2.7	0.0
Wood Village	0.0	0.0	0.0	0.0	0.0	0.0
Uninc. Clackamas	1.3	3.3	2.7	5.3	11.3	4.7
Uninc. Multnomah	0.3	0.0	0.0	0.3	0.3	0.3
Uninc. Washington	1.3	1.7	6.3	2.3	10.3	3.0
METRO	14.0	46.3	127.0	109.0	282.3	60.3

While Portland has the largest number and rate of serious pedestrian crashes, it is apparent from Figure 5-3 that there are a number of other cities and areas with a high rate of serious pedestrian crashes per capita. Gresham, Cornelius, Tigard, unincorporated Multnomah County, unincorporated Clackamas County, Tualatin, and Hillsboro all experience relatively high rates of serious pedestrian crashes.

City	Population (2010)	All injury per capita	Fatal/Incapacitating per capita
Beaverton	90,203	99.8	3.7
Cornelius	11,869	168.5	56.2
Durham	10,211	65.3	32.6
Damascus	1,306	255.2	0.0
Fairview	8,926	112.0	0.0
Forest Grove	21,094	126.4	31.6
Gladstone	11,529	115.7	28.9
Gresham	105,588	233.6	56.8
Happy Valley	13,906	119.9	0.0
Hillsboro	91,507	196.7	43.7
Johnson City	436	0.0	0.0
King City	3,090	0.0	0.0
Lake Oswego	36,586	136.7	0.0
Maywood Park	752	0.0	0.0
Milwaukie	20,560	145.9	32.4
Oregon City	32,476	92.4	10.3
Portland	583,627	288.4	57.7
Rivergrove	289	0.0	0.0
Sherwood	18,207	54.9	18.3
Tigard	48,058	159.5	55.5
Troutdale	15,800	168.8	21.1
Tualatin	26,102	140.5	51.1
West Linn	25,112	79.6	26.5
Wilsonville	19,509	136.7	0.0
Wood Village	3,878	0.0	0.0
Uninc. Clackamas	87,502	129.5	53.3
Uninc. Multnomah	6,018	55.4	55.4
Uninc. Washington	186,977	55.3	16.0
METRO	1,481,118	190.6	40.7

Figure 5-3



By Month

Month	All injury crashes	Fatal/ Incapac.
January	30.0	6.3
February	24.7	5.3
March	23.0	7.0
April	18.7	3.7
May	24.3	4.3
June	17.0	5.7
July	18.3	3.7
August	13.3	2.0
September	18.3	2.3
October	29.0	8.0
November	31.7	5.7
December	34.0	6.3

Figure 5-4

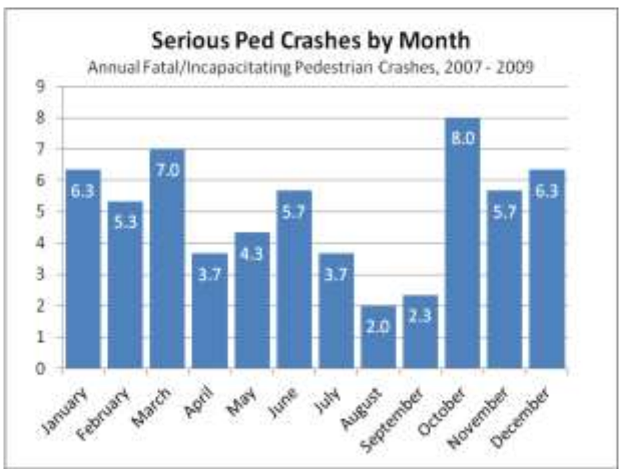


Figure 5-4 presents the annual average number of serious crashes by month. Fall and winter months generally have more serious pedestrian crashes.

By Time of Day

Figure 5-5

Serious Pedestrian Crashes by Day of Week and Hour

Annual Fatal/Incapacitating Pedestrian Crashes, 2007 - 2009

Hour	Sun	Mon	Tue	Wed	Thu	Fri	Sat
12 AM	0.3	0.0	0.0	0.0	0.0	0.0	0.7
1 AM	0.0	0.0	0.0	0.0	0.3	0.0	1.0
2 AM	0.0	0.0	0.0	0.0	0.0	0.0	0.3
3 AM	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4 AM	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 AM	0.0	0.3	0.3	0.3	0.0	1.0	0.0
6 AM	0.0	0.3	0.7	0.7	1.3	0.3	0.0
7 AM	0.0	0.7	0.3	0.3	1.0	1.7	0.0
8 AM	0.0	0.7	0.3	0.3	0.7	0.0	0.0
9 AM	0.0	0.0	0.3	0.0	0.3	0.0	0.0
10 AM	0.7	0.0	0.0	0.7	0.0	0.0	0.3
11 AM	0.3	0.0	0.3	0.3	0.3	0.7	0.3
12 PM	0.3	0.7	0.0	0.3	0.0	0.3	0.7
1 PM	0.7	0.0	0.3	0.0	0.0	0.0	0.3
2 PM	0.0	0.3	0.3	0.3	0.0	0.0	0.3
3 PM	0.0	0.7	0.3	0.7	0.7	0.7	1.0
4 PM	0.7	0.0	2.3	1.0	0.0	0.7	0.3
5 PM	0.7	1.3	0.7	0.7	0.7	1.3	0.7
6 PM	0.7	0.7	0.7	0.3	0.7	0.3	0.7
7 PM	0.3	0.3	1.0	0.3	0.0	0.7	1.0
8 PM	0.0	0.0	0.3	1.0	1.0	0.7	0.7
9 PM	0.0	0.3	0.3	1.3	1.0	0.3	1.0
10 PM	0.0	0.3	0.3	0.3	0.3	1.0	1.0
11 PM	0.7	0.0	0.3	0.0	0.3	0.7	0.3
	Sun	Mon	Tue	Wed	Thu	Fri	Sat
All Day	5.3	6.7	9.3	9.0	8.7	10.3	10.7

Hour	Average Wkday	Average Wkend
12 AM	0.0	0.5
1 AM	0.1	0.5
2 AM	0.0	0.2
3 AM	0.0	0.0
4 AM	0.0	0.0
5 AM	0.4	0.0
6 AM	0.7	0.0
7 AM	0.8	0.0
8 AM	0.4	0.0
9 AM	0.1	0.0
10 AM	0.1	0.5
11 AM	0.3	0.3
12 PM	0.3	0.5
1 PM	0.1	0.5
2 PM	0.2	0.2
3 PM	0.6	0.5
4 PM	0.8	0.5
5 PM	0.9	0.7
6 PM	0.5	0.7
7 PM	0.5	0.7
8 PM	0.6	0.3
9 PM	0.7	0.5
10 PM	0.5	0.5
11 PM	0.3	0.5
	Average Wkday	Average Wkend
All Day	8.8	8.0

Figure 5-5 presents the rate of serious pedestrian crashes by day of the week and hour of the day using a "heat map" format. Red cells indicate the highest relative crash time periods; green indicate the lowest relative crash time periods. The average weekday and weekend day are summarized on the right side of the figure, while each day is summarized and compared at the bottom of the figure.

The weekday evening peak hours produce the highest number of serious pedestrian crashes, mirroring the pattern for all crashes, with the 5:00 – 5:59 pm hour as the worst. A larger proportion of evening crashes are evident as compared to all crashes. Late Friday night/early Saturday morning and late Saturday night show somewhat high rates of serious pedestrian crashes. Saturday and Friday have the highest rates of serious pedestrian crashes.

By Weather

Weather	Annual crashes	All injury crashes	Fatal/ Incapac.
Cloudy/Clear	226.0	214.7	47.0
Rain/Fog	64.7	60.0	12.0
Sleet/Snow	3.7	3.7	0.7
Unknown	5.0	4.0	0.7
METRO	299.3	282.3	60.3

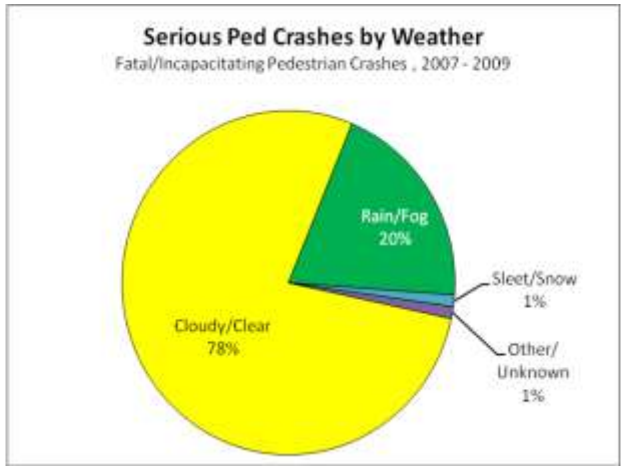


Figure 5-6

The majority (78%) of serious pedestrian crashes occurred in clear or cloudy conditions (Figure 5-6), as compared to 80% for all crashes (Figure 2-16).

By Road Surface Condition

Road	Annual crashes	All injury crashes	Fatal/ Incapac.
Dry	206.7	196.0	43.0
Ice/Snow	4.0	4.0	0.7
Wet	84.3	79.0	16.0
Unknown	4.3	3.3	0.7
METRO	299.3	282.3	60.3

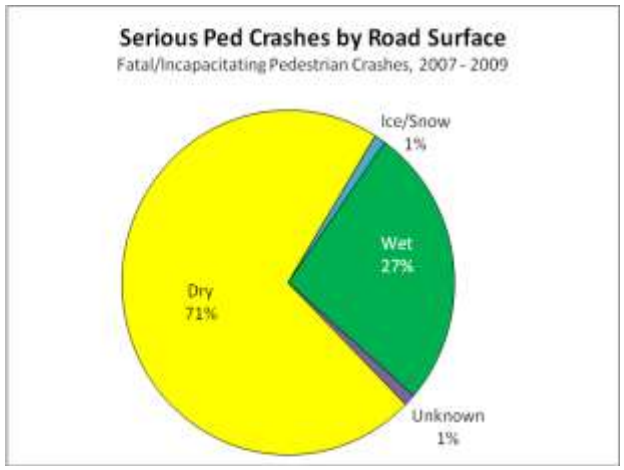


Figure 5-7

The majority (71%) of serious pedestrian crashes occurred in dry conditions (Figure 5-7), as compared to 73% for all crashes (Figure 2-17).

By Lighting

Lighting	Annual crashes	All injury crashes	Fatal/ Incapac.
Daylight	168.0	162.7	28.0
Dawn/Dusk	24.0	23.3	5.3
Night - Dark	84.0	76.0	19.0
Night - Lit	22.7	20.0	8.0
Unknown	0.7	0.3	0.0
METRO	299.3	282.3	60.3

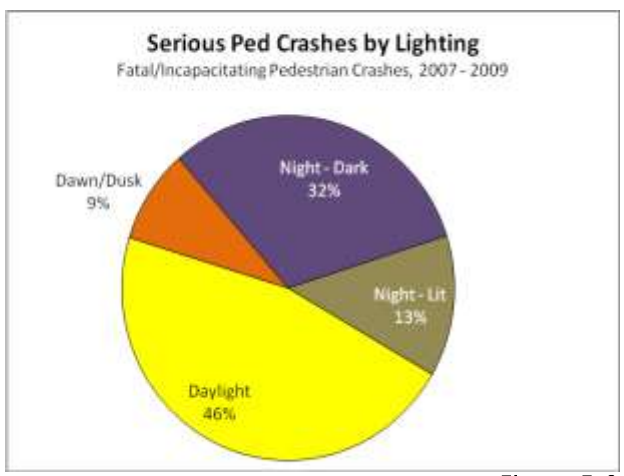


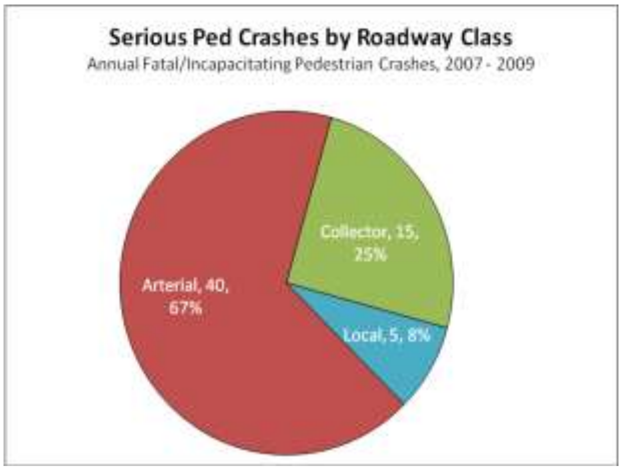
Figure 5-8

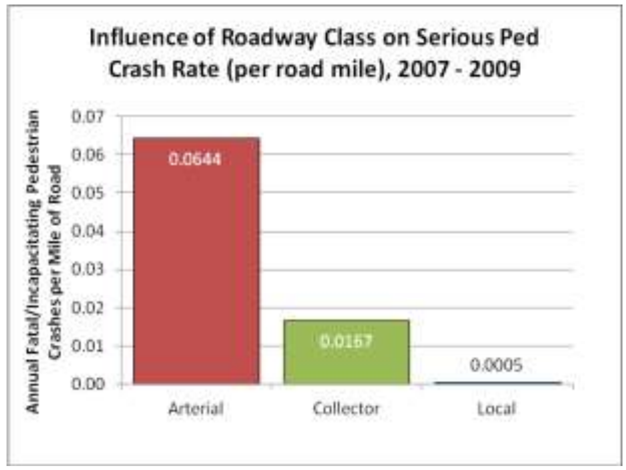
Only 46% of serious pedestrian crashes occurred in daylight (Figure 5-8), as compared to 64% for all crashes (Figure 2-18). Serious pedestrian crashes are more likely after dark than other modes, especially where street lighting is not present.

By Roadway Classification

	Total Length	All injury crashes	Fatal/ Incapac.	% Fatal/ Incapac.	Fatal/Incapac. Per mile
Arterial	626.7	183.3	40.3	20.5%	0.0644
Collector	900.0	75.3	15.0	19.1%	0.0167
Local	10,394.2	23.7	5.0	20.3%	0.0005
METRO	11,920.9	282.3	60.3	20.2%	0.0051

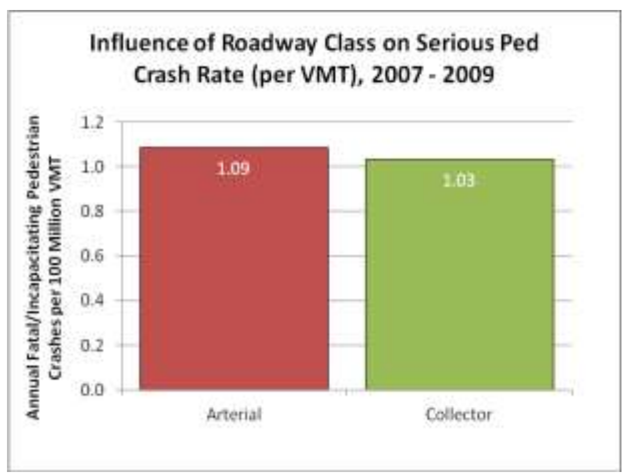
Figures 5-9 and 5-10





As with overall crashes, the region's serious pedestrian crashes occur primarily on the arterials, accounting for 67% of them. Figure 5-9 presents the distribution of serious pedestrian crashes by roadway classification. As can be seen in Figure 5-10, which presents the rate of serious pedestrian crashes per mile of roadway, arterial roadways are nearly 4 times as likely as collectors per mile to be the location of a serious pedestrian crash, and more than 125 times as likely as local streets per mile to be the location of a serious pedestrian crash.

Figure 5-11



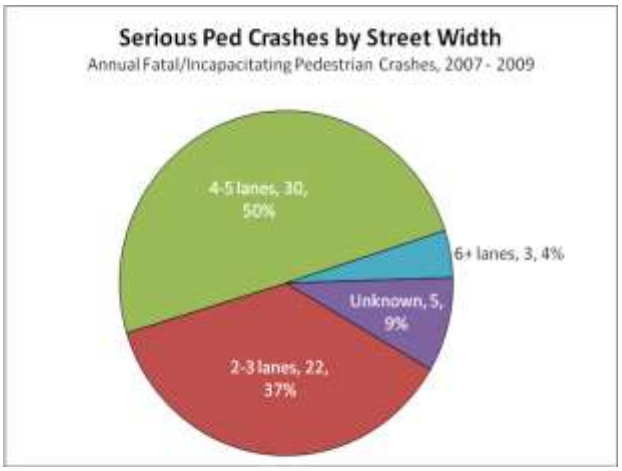
As can be seen in Figure 5-11, when normalized by motor vehicle traffic volume, the serious pedestrian crash rate on arterials is still higher than on collectors. Vehicle miles travelled was not available for local streets.

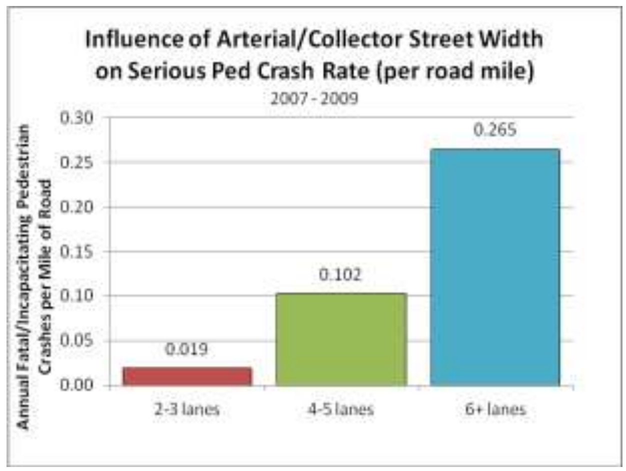
Many transit routes follow arterial roadways, increasing the need for people to cross these roadways safely.

By Number of Lanes

Number of Lanes	Total Length	All injury crashes	Fatal/ Incapac.	% Fatal/ Incapac.	Fatal/Incapac. Per mile
2 – 3 Lanes	1,180.5	107.7	22.3	19.82%	0.019
4 – 5 Lanes	292.9	138.0	30.0	20.22%	0.102
6+ Lanes	10.1	12.7	2.7	20.00%	0.265
Unknown	--	24.0	5.3	21.33%	--
METRO	1,483.5	282.3	60.3	20.16%	--

Figures 5-12 and 5-13



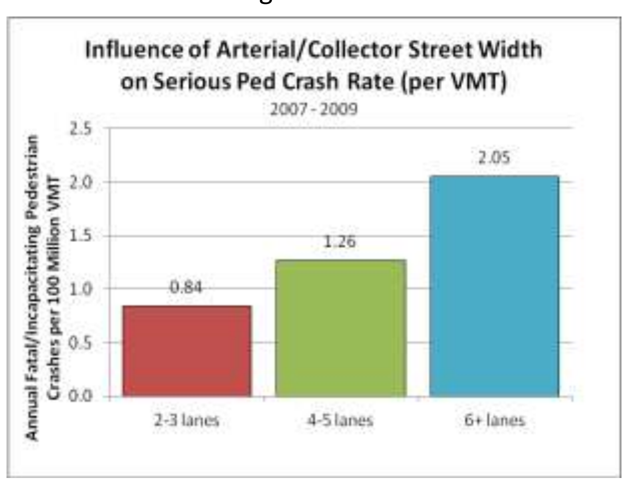


The influence of street width is consistent with the influence of roadway classification (Figure 5-12). Wider roadways are the location of a disproportionate number of serious pedestrian crashes in relation to both their share of the overall system (Figure 5-13) and the vehicle-miles travelled they serve (Figure 5-14). The serious pedestrian crash rate increases dramatically for roadways with 4 or more lanes, and again for roadways with 6 or more lanes. This effect is in spite of the fact that such arterials often discourage pedestrian travel in the first place, thereby reducing potential pedestrian exposure.

As can be seen in Figure 5-14, even when normalized by motor vehicle traffic volume, the serious pedestrian crash rate on wider roadways is still substantially higher than on narrower roads. Wider roadways are particularly hazardous to pedestrians.

Many transit routes follow wider roadways, increasing the need for people to cross these roadways safely.

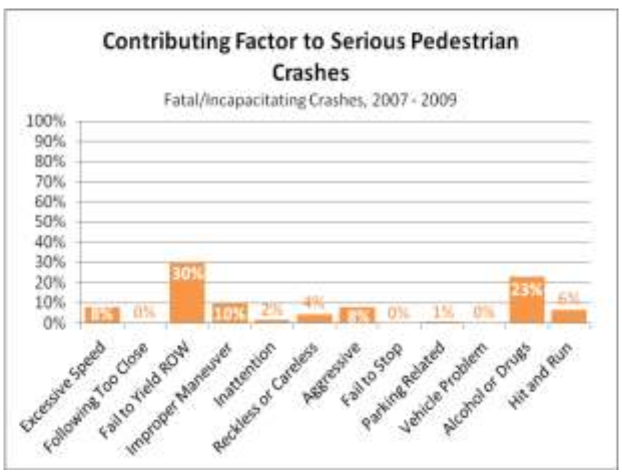
Figure 5-14



By Contributing Factor

Factor	Annual Crashes	Fatal Crashes	Injury A Crashes	Injury B Crashes	Injury C Crashes	All Injury Crashes	Fatal/ Incapac.
Excessive Speed	8	3	2	1	1	5	5
Following Too Close	0	0	0	0	0	0	0
Fail to Yield ROW	155	3	14	70	66	150	17
Improper Maneuver	14	1	4	4	4	12	6
Inattention	5	0	1	2	2	5	1
Reckless or Careless	8	1	1	4	1	7	2
Aggressive	8	3	2	1	1	5	5
Fail to Stop	1	0	0	1	0	1	0
Parking Related	0	0	0	0	0	0	0
Vehicle Problem	1	0	0	1	0	1	0
Alcohol or Drugs	32	6	7	10	9	26	13
Hit and Run	11	2	1	4	3	8	4
METRO	290	14	44	124	104	273	58

Figures 5-15 and 5-16



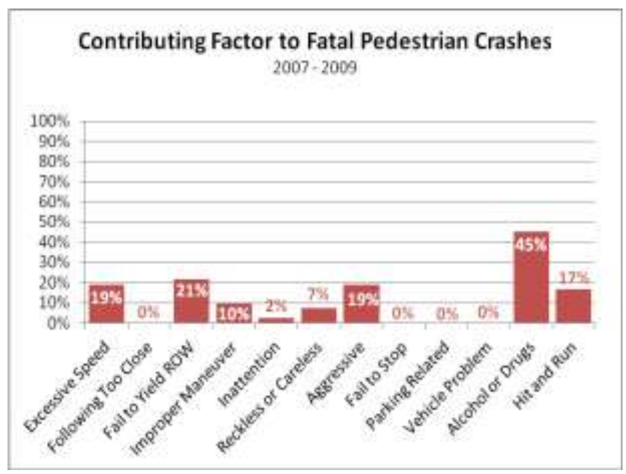


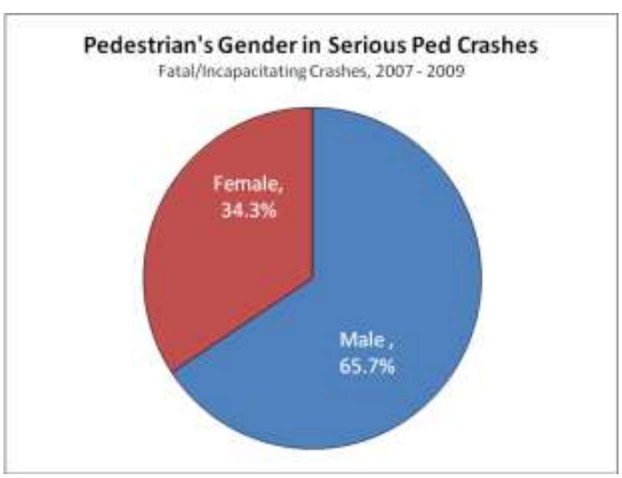
Figure 5-15 and 5-16 present the proportion of pedestrian crashes by contributing factor for serious and fatal crashes, respectively. Alcohol or Drugs, Failure to Yield, and Speed are the most common factors. The data do not specify whether the driver, the pedestrian, or both were under the influence of alcohol. Other factors, such as Failure to Yield and Speed, are for the driver.

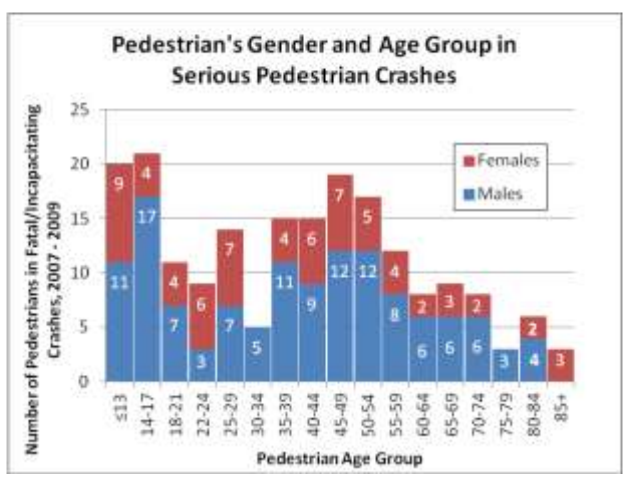
By Pedestrian's Age and Gender

The age and gender of pedestrians involved in crashes are presented in the following table and Figures 5-17 and 5-18.

	Number of Male Pedestrians			Number of Female Pedestrians		
Males	All Crashes	Fatal/ Incapac.	Percent Fatal/ Incapac.	All Crashes	Fatal/ Incapac.	Percent Fatal/ Incapac.
≤13	48	11	22.9%	37	9	24.3%
14-17	56	17	30.4%	32	4	12.5%
18-21	47	7	14.9%	41	4	9.8%
22-24	34	3	8.8%	22	6	27.3%
25-29	50	7	14.0%	42	7	16.7%
30-34	37	5	13.5%	17	0	0.0%
35-39	40	11	27.5%	29	4	13.8%
40-44	39	9	23.1%	38	6	15.8%
45-49	51	12	23.5%	23	7	30.4%
50-54	37	12	32.4%	39	5	12.8%
55-59	32	8	25.0%	24	4	16.7%
60-64	20	6	30.0%	19	2	10.5%
65-69	17	6	35.3%	14	3	21.4%
70-74	20	6	30.0%	6	2	33.3%
75-79	8	3	37.5%	4	0	0.0%
80-84	6	4	66.7%	7	2	28.6%
85+	3	0	0.0%	4	3	75.0%
Unknown	29	5	17.2%	21	1	4.8%
Total	**574**	**132**	**23.0%**	**419**	**69**	**16.5%**

Figures 5-17 and 5-18



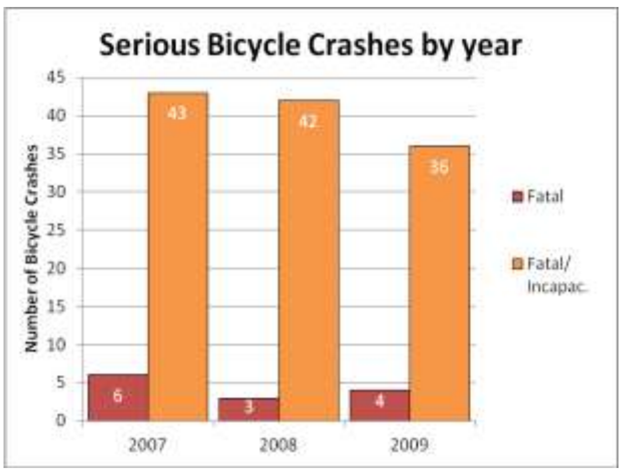


Section 6 – Bicyclists (Non-Freeway Crashes)

By Year

Year	Fatal Crashes (Fatalities)	Injury A Crashes	Injury B Crashes	Injury C Crashes	All Injury Crashes	Fatal/ Incapac.
2007	6 (6)	37	158	85	280	43
2008	3 (3)	39	210	115	364	42
2009	4 (4)	32	222	128	382	36
METRO	13 (13)	108	590	328	1,026	121

Figure 6-1



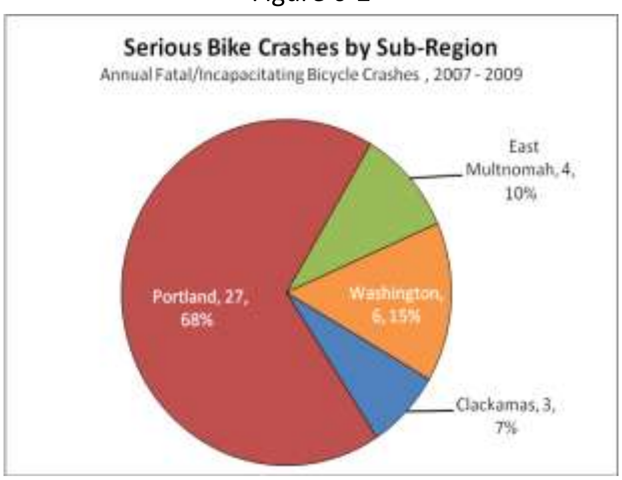
As presented in Figure 6-1, serious bicycle crashes declined over the 3-year period, while fatal bicycle crashes fluctuated.

By Sub-Region

County	Fatal crashes	Injury A crashes	Injury B crashes	Injury C crashes	All Injury crashes	Fatal/ Incapac.
Clackamas	0.3	2.7	7.7	17.0	27.3	3.0
Portland	2.7	24.7	135.7	67.3	227.7	27.3
East Multnomah	0.3	3.7	14.0	8.3	26.0	4.0
Washington	1.0	5.0	39.7	17.3	62.0	6.0
METRO	4.3	36.0	196.7	109.3	342.0	40.3

			All injury		Serious Crashes (Fatal/Incapacitating)	
County	Population	Total VMT	per capita	per VMT	per capita	per VMT
Clackamas	256,986	1,102,387,348	106.4	2.5	11.7	0.27
Portland	583,627	2,456,278,457	390.1	9.3	46.8	1.11
East Multnomah	136,130	491,944,454	191.0	5.3	29.4	0.81
Washington	499,259	1,811,815,622	124.2	3.4	12.0	0.33
METRO	1,481,118	5,854,310,275	230.9	5.8	27.2	0.69

Figure 6-2



With the highest population, transit usage, VMT, and number of bicyclists, Portland has 68% of the region's serious bicycle crashes (Figure 6-2). Portland also has the highest rate of serious bicycle crashes per capita and per VMT. East Multnomah County has moderate rates of serious bicycle crashes per capita and per VMT. Clackamas County and Washington County have relatively low rates of serious bicycle crashes, which is likely largely due to fewer people cycling.

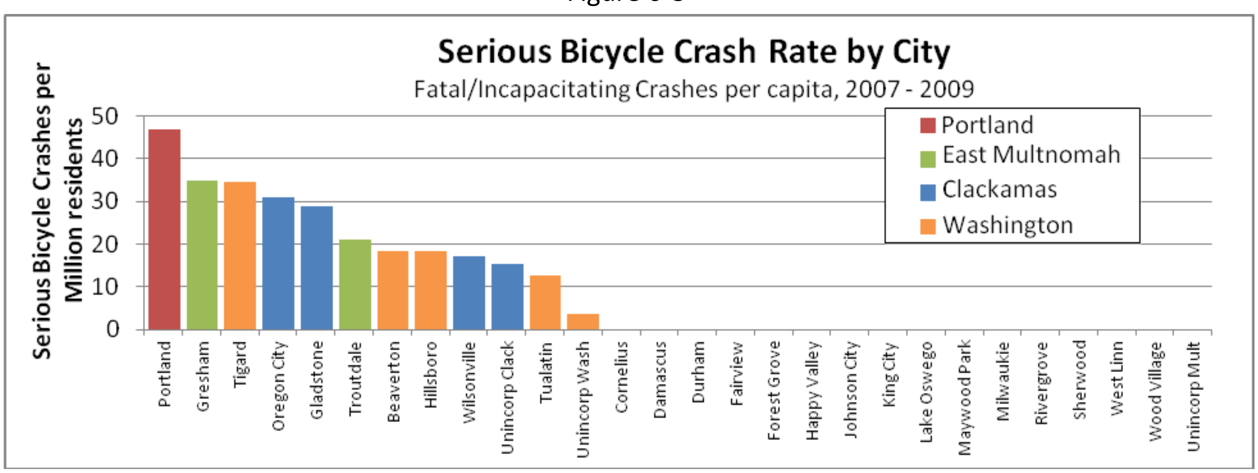
By City

City	Fatal crashes	Injury A crashes	Injury B crashes	Injury C crashes	All Injury crashes	Fatal/ Incapac.
Beaverton	0.3	1.3	9.7	4.0	15.0	1.7
Cornelius	0.0	0.0	0.0	1.3	1.3	0.0
Durham	0.0	0.0	0.0	0.0	0.0	0.0
Damascus	0.0	0.0	0.0	0.0	0.0	0.0
Fairview	0.0	0.0	0.3	0.0	0.3	0.0
Forest Grove	0.0	0.0	1.7	0.3	2.0	0.0
Gladstone	0.0	0.3	0.0	0.7	1.0	0.3
Gresham	0.3	3.3	11.7	8.0	23.0	3.7
Happy Valley	0.0	0.0	0.0	1.3	1.3	0.0
Hillsboro	0.7	1.0	9.0	5.7	15.7	1.7
Johnson City	0.0	0.0	0.0	0.0	0.0	0.0
King City	0.0	0.0	0.0	0.0	0.0	0.0
Lake Oswego	0.0	0.0	0.7	2.7	3.3	0.0
Maywood Park	0.0	0.0	0.0	0.0	0.0	0.0
Milwaukie	0.0	0.0	1.3	1.7	3.0	0.0
Oregon City	0.0	1.0	0.7	2.0	3.7	1.0
Portland	2.7	24.7	135.7	67.3	227.7	27.3
Rivergrove	0.0	0.0	0.0	0.0	0.0	0.0
Sherwood	0.0	0.0	1.3	0.3	1.7	0.0
Tigard	0.0	1.7	5.3	1.7	8.7	1.7
Troutdale	0.0	0.3	1.3	0.0	1.7	0.3
Tualatin	0.0	0.3	4.7	1.0	6.0	0.3
West Linn	0.0	0.0	0.3	2.3	2.7	0.0
Wilsonville	0.0	0.3	0.0	0.7	1.0	0.3
Wood Village	0.0	0.0	0.7	0.3	1.0	0.0
Uninc. Clackamas	0.3	1.0	4.3	5.3	10.7	1.3
Uninc. Multnomah	0.0	0.0	0.0	0.0	0.0	0.0
Uninc. Washington	0.0	0.7	8.0	2.7	11.3	0.7
METRO	4.3	36.0	196.7	109.3	342.0	40.3

While Portland has the largest number and rate of serious bicycle crashes, it is apparent from Figure 6-3 that there are a number of other cities with a high rate of serious bicycle crashes per capita. Gresham, Tigard, Oregon City, and Gladstone all experience relatively high rates of serious bicycle crashes.

County	Population (2010)	All injury per capita	Fatal/Incapacitating per capita
Beaverton	90,203	166.3	18.5
Cornelius	11,869	112.3	0.0
Durham	10,211	0.0	0.0
Damascus	1,306	0.0	0.0
Fairview	8,926	37.3	0.0
Forest Grove	21,094	94.8	0.0
Gladstone	11,529	86.7	28.9
Gresham	105,588	217.8	34.7
Happy Valley	13,906	95.9	0.0
Hillsboro	91,507	171.2	18.2
Johnson City	436	0.0	0.0
King City	3,090	0.0	0.0
Lake Oswego	36,586	91.1	0.0
Maywood Park	752	0.0	0.0
Milwaukie	20,560	145.9	0.0
Oregon City	32,476	112.9	30.8
Portland	583,627	390.1	46.8
Rivergrove	289	0.0	0.0
Sherwood	18,207	91.5	0.0
Tigard	48,058	180.3	34.7
Troutdale	15,800	105.5	21.1
Tualatin	26,102	229.9	12.8
West Linn	25,112	106.2	0.0
Wilsonville	19,509	51.3	17.1
Wood Village	3,878	257.9	0.0
Uninc. Clackamas	87,502	121.9	15.2
Uninc. Multnomah	6,018	0.0	0.0
Uninc. Washington	186,977	60.6	3.6
METRO	1,481,118	230.9	27.2

Figure 6-3



By Month

Month	All injury crashes	Fatal/ Incapac.
January	14.0	2.0
February	16.0	2.3
March	14.3	2.7
April	28.7	3.7
May	32.7	4.7
June	35.3	3.3
July	41.0	4.0
August	43.3	4.0
September	47.0	3.7
October	30.7	4.7
November	22.7	4.7
December	16.3	0.7

Figure 6-4

Figure 6-4 presents the annual average number of serious bicycle crashes by month. April through November generally have more serious bicycle crashes, likely related to the higher number of people cycling in the warm and dry months.

By Time of Day

Figure 6-5

Serious Bicycle Crashes by Day of Week and Hour

Annual Fatal/Incapacitating Bicycle Crashes, 2007 – 2009

Hour	Sun	Mon	Tue	Wed	Thu	Fri	Sat
12 AM	0.3	0.0	0.0	0.0	0.3	0.3	0.3
1 AM	0.0	0.0	0.0	0.0	0.3	0.0	0.3
2 AM	0.0	0.0	0.0	0.3	0.3	0.0	0.3
3 AM	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4 AM	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 AM	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6 AM	0.3	0.3	1.0	0.0	0.0	0.3	0.0
7 AM	0.3	0.0	0.3	0.0	0.7	0.3	0.0
8 AM	0.0	0.3	0.3	0.3	0.3	0.0	0.3
9 AM	0.0	0.3	0.0	0.3	0.3	0.3	0.3
10 AM	0.3	0.0	0.0	0.7	0.0	0.0	0.3
11 AM	0.3	0.0	0.0	0.3	0.7	0.3	0.3
12 PM	0.0	0.3	0.0	0.3	0.0	0.7	0.0
1 PM	0.3	0.3	0.0	0.3	0.3	0.0	0.0
2 PM	0.0	0.3	0.0	1.3	0.0	0.0	0.7
3 PM	0.7	0.0	0.3	0.0	0.3	1.0	0.7
4 PM	0.0	1.0	0.3	1.3	1.0	0.3	0.3
5 PM	0.3	0.7	1.0	1.3	1.7	0.7	0.0
6 PM	0.3	0.7	0.3	0.0	0.7	1.0	0.3
7 PM	0.7	0.0	0.0	0.0	0.7	0.3	0.0
8 PM	0.0	0.0	0.7	0.0	0.3	0.0	0.0
9 PM	0.3	0.0	0.0	0.0	0.3	0.0	0.0
10 PM	0.0	0.0	0.3	0.0	0.0	0.3	0.0
11 PM	0.3	0.3	0.3	0.0	0.3	0.3	0.0

Hour	Average Wkday	Average Wkend
12 AM	0.1	0.3
1 AM	0.1	0.2
2 AM	0.1	0.2
3 AM	0.0	0.0
4 AM	0.0	0.0
5 AM	0.0	0.0
6 AM	0.3	0.2
7 AM	0.3	0.2
8 AM	0.3	0.2
9 AM	0.3	0.2
10 AM	0.1	0.3
11 AM	0.3	0.3
12 PM	0.3	0.0
1 PM	0.2	0.2
2 PM	0.3	0.3
3 PM	0.3	0.7
4 PM	0.8	0.2
5 PM	1.1	0.2
6 PM	0.5	0.3
7 PM	0.2	0.3
8 PM	0.2	0.0
9 PM	0.1	0.2
10 PM	0.1	0.0
11 PM	0.3	0.2

	Sun	Mon	Tue	Wed	Thu	Fri	Sat
All Day	4.7	4.7	5.0	6.7	8.7	6.3	4.3

	Average Wkday	Average Wkend
All Day	6.3	4.5

Figure 6-5 presents the rate of serious bicycle crashes by day of the week and hour of the day using a "heat map" format. Red cells indicate the highest relative crash time periods; green indicate the lowest relative crash time periods. The average weekday and weekend day are summarized on the right side of the figure, while each day is summarized and compared at the bottom of the figure.

The weekday evening peak hours produce the highest number of serious bicycle crashes, mirroring the pattern for all crashes, with the 5:00 – 5:59 pm hour as the worst. No other clear trends are evident.

By Weather

Weather	Annual crashes	All injury crashes	Fatal/ Incapac.
Cloudy/Clear	326.7	307.0	34.7
Rain/Fog	33.3	32.0	5.3
Sleet/Snow	0.0	0.0	0.0
Unknown	5.0	3.0	0.3
Total	365.0	342.0	40.3

The majority (86%) of serious bicycle crashes occurred in clear or cloudy conditions (Figure 6-6), as compared to 80% for all crashes (Figure 2-16).

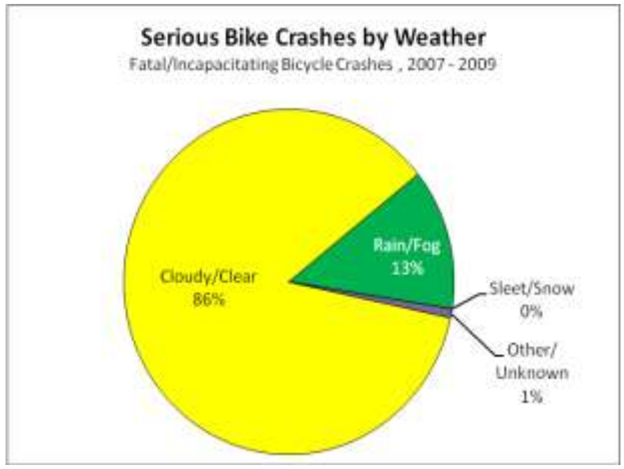


Figure 6-6

By Road Surface Condition

Road	Annual crashes	All injury crashes	Fatal/ Incapac.
Dry	309.0	291.0	32.0
Ice/Snow	0.7	0.3	0.3
Wet	49.7	47.0	7.7
Unknown	5.7	3.7	0.3
Total	365.0	342.0	40.3

The majority (79%) of serious pedestrian crashes occurred in dry conditions (Figure 6-7), as compared to 73% for all crashes (Figure 2-17).

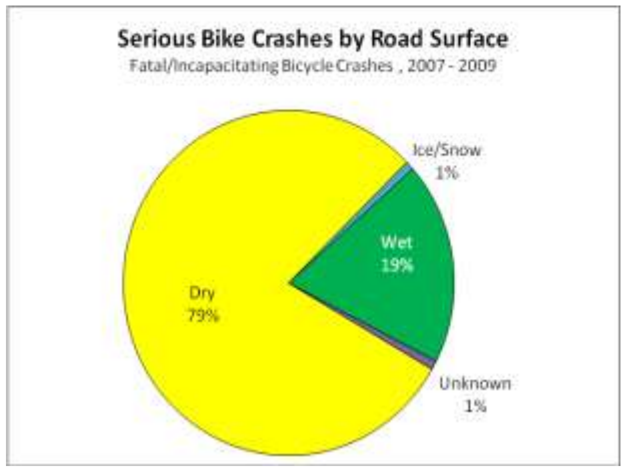


Figure 6-7

By Lighting

Lighting	Annual crashes	All injury crashes	Fatal/ Incapac.
Daylight	286.0	268.7	28.7
Dawn/Dusk	18.7	17.7	2.0
Night - Dark	50.7	46.3	9.7
Night - Lit	9.0	8.7	0.0
Unknown	0.7	0.7	0.0
Total	365.0	342.0	40.3

The majority (71%) of serious bicycle crashes occurred in daylight (Figure 6-8), as compared to 73% for all crashes (Figure 2-18).

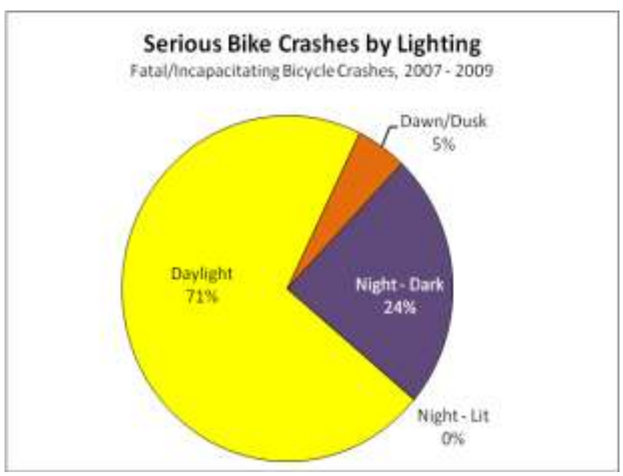
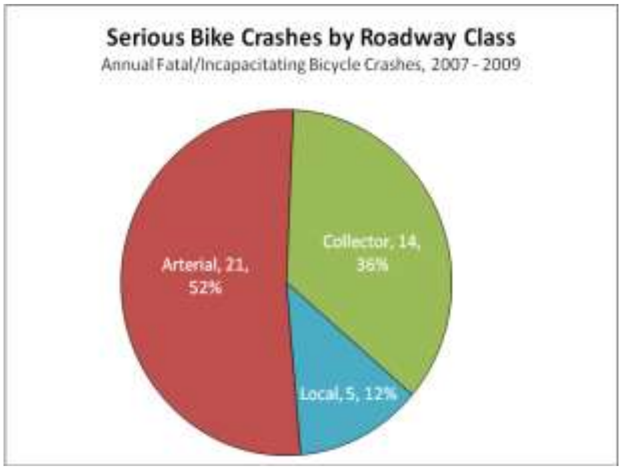


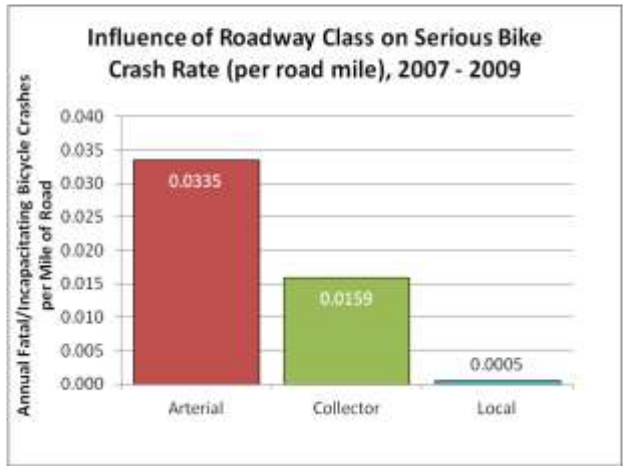
Figure 6-8

By Roadway Classification

	Total Length	All injury crashes	Fatal/ Incapac.	% Fatal/ Incapac.	Fatal/Incapac. Per mile
Arterial	626.7	183.0	21.0	10.7%	0.0335
Collector	900.0	112.7	14.3	12.0%	0.0159
Local	10,394.2	46.3	5.0	10.2%	0.0005
METRO	11,920.9	342.0	40.3	11.1%	0.0034

Figures 6-9 and 6-10

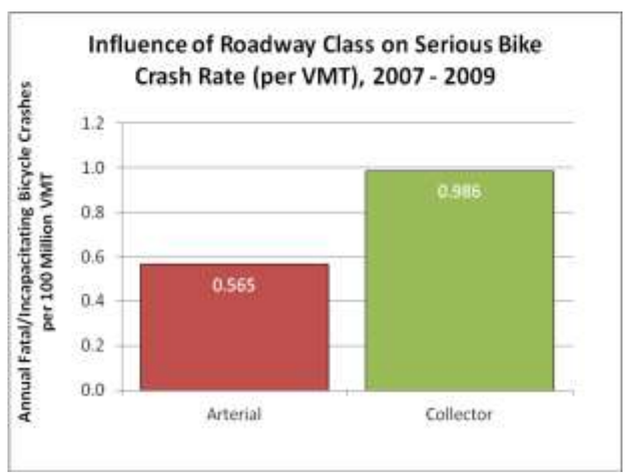




As with all crashes, the region's serious bicycle crashes occur primarily on the arterials, accounting for 52% of them. Figure 6-9 presents the distribution of serious bicycle crashes by roadway classification. As can be seen in Figure 6-10, which presents the rate of serious bicycle crashes per mile of roadway, arterial roadways are more than twice as likely than collectors per mile to be the location of a serious bicycle crash, and more than 60 times as likely than local streets per mile to be the location of a serious bicycle crash.

As can be seen in Figure 6-11, when normalized by motor vehicle traffic volume, the serious bike crash rate on collectors is higher than on arterials. While the reason for this is not clear from the data, it may be related to a higher use of collector roads by cyclists relative to traffic volume as compared to arterials. Vehicle miles travelled was not available for local streets.

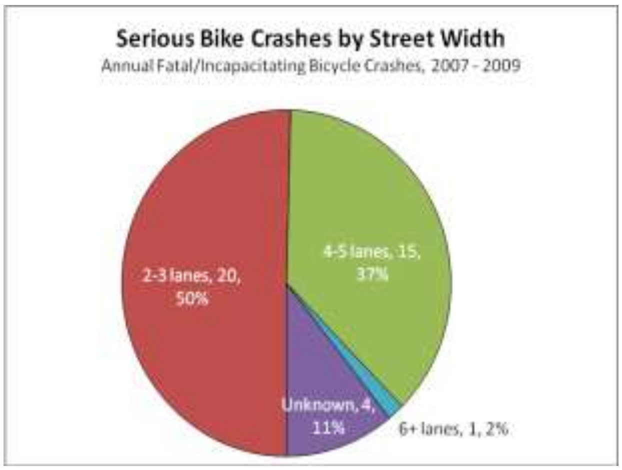
Figure 6-11

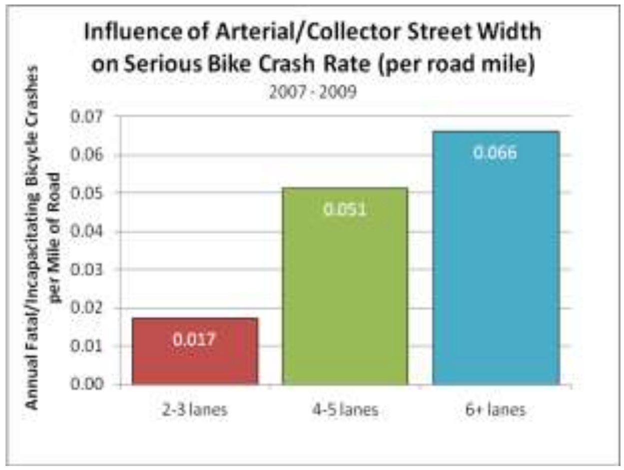


By Number of Lanes

Number of Lanes	Total Length	All injury crashes	Fatal/ Incapac.	% Fatal/ Incapac.	Fatal/Incapac. Per mile
2 – 3 Lanes	1,180.5	159.7	20.3	11.98%	0.017
4 – 5 Lanes	292.9	128.3	15.0	10.82%	0.051
6+ Lanes	10.1	9.7	0.7	6.90%	0.066
Unknown	--	44.3	4.3	9.22%	--
Total	--	342.0	40.3	11.05%	--

Figure 6-12 and 6-13

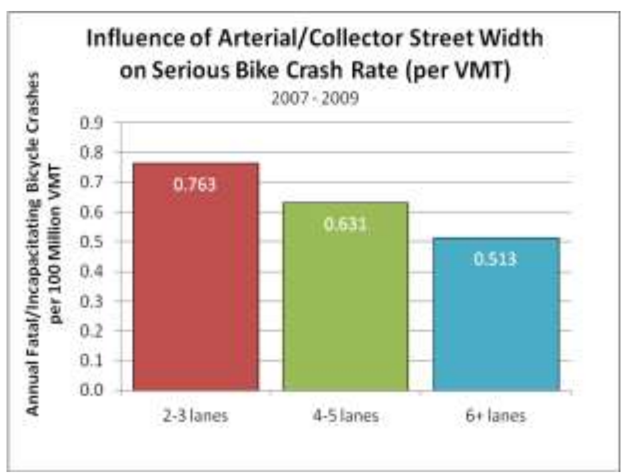




The influence of street width is consistent with the influence of roadway classification (Figure 6-12). Wider roadways are the location of a disproportionate number of serious bicycle crashes in relation to their share of the overall system (Figure 6-13), although the effect is not as pronounced as it is for serious pedestrian crashes. The serious bicycle crash rate per road mile increases dramatically for roadways with 4 or more lanes. This is a concern, given that in many parts of the region, designated bicycling routes often follow arterial roadways with 4 or more lanes.

As can be seen in Figure 6-14, when normalized by motor vehicle traffic volume, the serious bike crash rate on narrower roads is higher than on wider roads. While the reason for this is not clear from the data, it may be related to a higher use of narrower roads by cyclists relative to traffic volume as compared to multi-lane roadways.

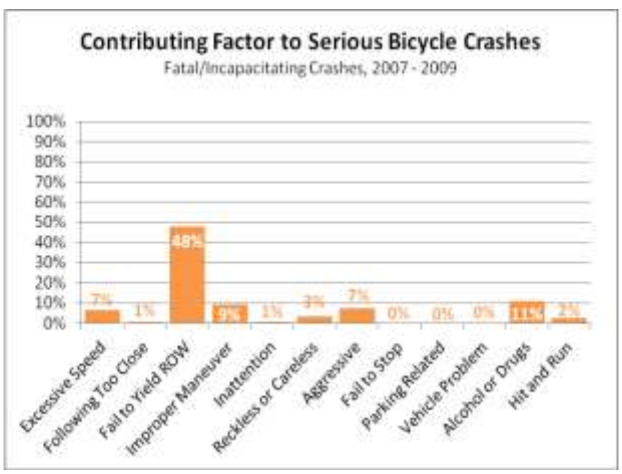
Figure 6-14



By Contributing Factor

Factor	Annual Crashes	Fatal Crashes	Injury A Crashes	Injury B Crashes	Injury C Crashes	All Injury Crashes	Fatal/ Incapac.
Excessive Speed	4	1	2	1	0	3	3
Following Too Close	3	0	0	1	2	3	0
Fail to Yield ROW	193	1	18	105	59	183	19
Improper Maneuver	25	0	3	14	7	25	4
Inattention	1	0	0	0	1	1	0
Reckless or Careless	7	0	1	4	1	7	1
Aggressive	6	1	2	1	2	5	3
Fail to Stop	1	0	0	1	0	1	0
Parking Related	1	0	0	1	0	1	0
Vehicle Problem	0	0	0	0	0	0	0
Alcohol or Drugs	15	2	2	6	4	12	4
Hit and Run	8	1	0	2	3	5	1
METRO	365	4	36	197	109	342	40

Figures 6-15 and 6-16



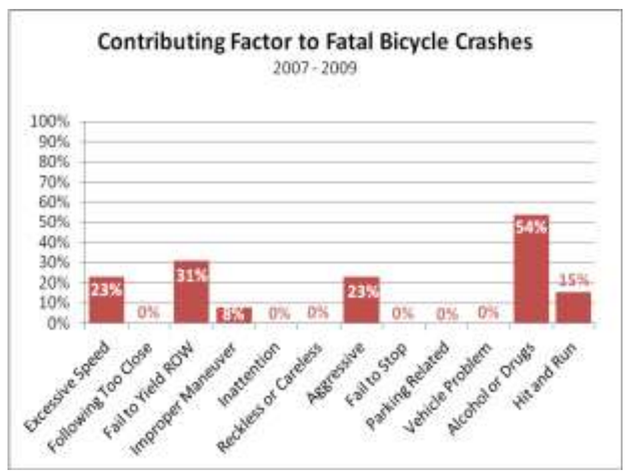


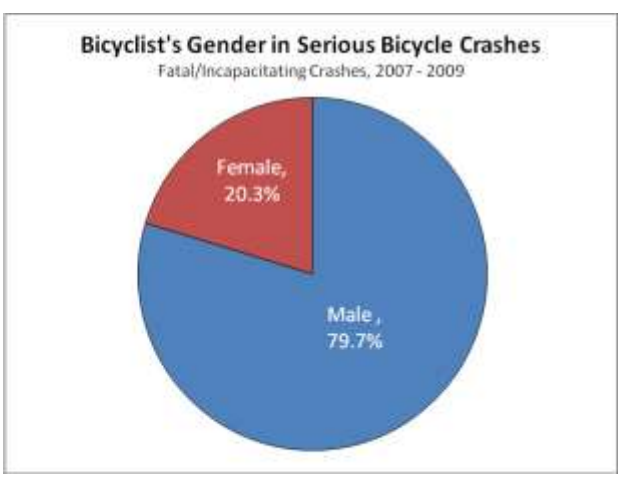
Figure 5-15 and 5-16 present the proportion of pedestrian crashes by contributing factor for serious and fatal crashes, respectively. Alcohol or Drugs, Failure to Yield, and Speed are the most common factors. The data do not specify whether the driver, the bicyclist, or both were under the influence of alcohol. Other factors, such as Failure to Yield and Speed, are for the driver.

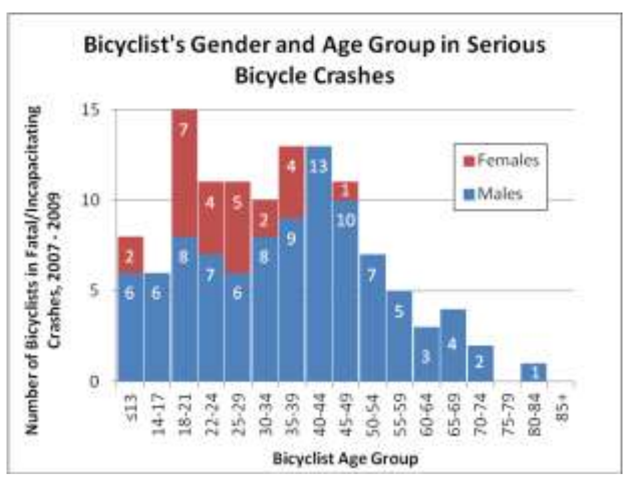
By Bicyclist's Age and Gender

The age and gender of bicyclists involved in serious crashes are presented in the following table and Figures 6-17 and 6-18.

	Males			Females		
Males	All Crashes	Fatal/ Incapac.	Percent Fatal/ Incapac.	All Crashes	Fatal/ Incapac.	Percent Fatal/ Incapac.
≤13	61	6	9.8%	15	2	13.3%
14-17	83	6	7.2%	22	0	0.0%
18-21	90	8	8.9%	46	7	15.2%
22-24	65	7	10.8%	32	4	12.5%
25-29	87	6	6.9%	49	5	10.2%
30-34	75	8	10.7%	23	2	8.7%
35-39	81	9	11.1%	23	4	17.4%
40-44	64	13	20.3%	16	0	0.0%
45-49	44	10	22.7%	13	1	7.7%
50-54	51	7	13.7%	9	0	0.0%
55-59	28	5	17.9%	3	0	0.0%
60-64	27	3	11.1%	2	0	0.0%
65-69	12	4	33.3%	0	0	--
70-74	7	2	28.6%	2	0	0.0%
75-79	2	0	0.0%	0	0	--
80-84	3	1	33.3%	0	0	--
85+	0	0	--	0	0	--
Unknown	96	3	3.1%	15	0	0.0%
Total	**876**	**98**	**11.2%**	**270**	**25**	**9.3%**

Figures 6-17 and 6-18





Section 7 – Crash Type Detail

In this section, the four crash types identified in Section 2 as most prevalent are reviewed relative to all crashes in more detail to identify patterns. As documented in Section 2, the most common serious crash types were Rear End and Turning, while the most common fatal crash types were Fixed Object and Pedestrian. More detail on Rear End, Turning, Fixed Object, and Pedestrian crashes are presented here.

For each crash type, detailed crash information was summarized for all crashes of that type. The information includes crash severity and contributing factors.

Crash Severity

Every crash is assigned a crash severity based on the most critically injured victim. From worst to best, the classifications are: Fatal, Injury A, Injury B, Injury C, and PDO (property damage only).

Contributing Factors

The State Department of Motor Vehicles assigns causes and errors to participants in each crash, along with identifiers for certain risk factors, including alcohol and drugs. Several causes, errors, and/or factors may apply to any single crash. Based on these causes, errors, and risk factors, crashes were evaluated for 12 contributing factors, defined for this analysis as follows:

Defined Contributing Factor	DMV codes included in factor
Excessive Speed	Speed too fast for conditions; Driving in excess of posted speed; Speed racing; Failed to decrease speed for slower moving vehicle
Following Too Close	Following too closely
Fail to Yield ROW (right-of-way)	Did not yield ROW; Passed stop sign or flashing red; Disregarded traffic signal; Disregarded other traffic control device; Failed to obey mandatory turn signal, sign or lane markings; Left turn in front of oncoming traffic; Did not have ROW over pedalcyclist; Did not have ROW; Failed to yield ROW to pedestrian; Passed vehicle stopped at crosswalk for pedestrian
Improper Maneuver	Drove left of center on two-way road; Improper overtaking; Made improper turn; Other improper driving; Wide turn; Cut corner on turn; Left turn where prohibited; Turned from or into wrong lane; U-turned illegally; Improper signal or failure to signal; Backing improperly (not parking); Improper start from stopped position; Disregarded warning sign, flares, or flashing amber; Passing on a curve, on wrong side, on straight road under unsafe conditions, at intersection, on crest of hill, in no passing zone, or in front of oncoming traffic; Driving on wrong side of road; Straddling or driving on wrong lanes; Improper change of lanes; Wrong way
Inattention	Driver drowsy/fatigued/sleepy; Inattention
Reckless or Careless	Reckless driving; Careless driving
Aggressive	Excessive Speed or Following too Close, as defined above
Fail to Stop	Failed to avoid stopped or parked vehicle ahead other than school bus
Parking Related	Improperly parked; Improper start leaving parked position; Improper parking; Opened door into adjacent traffic lane
Vehicle Problem	Improper or no lights; Driving unsafe vehicle (no other error apparent); Overloading or improper loading of vehicle with cargo or passengers
Alcohol or Drugs	Alcohol, Drugs
Hit and Run	Hit and Run

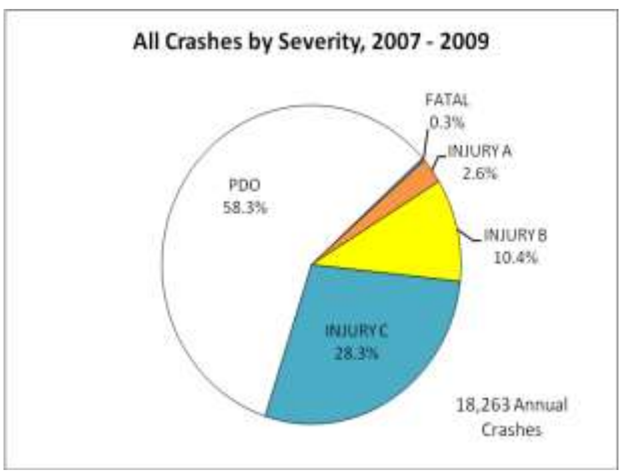
All Crash Types

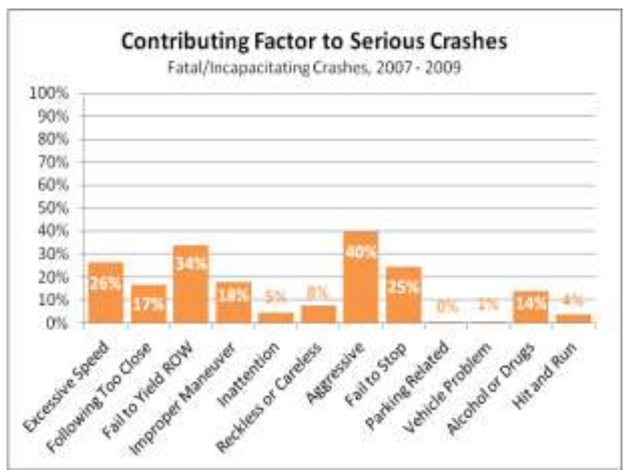
The following table summarizes all crashes in the region by severity and contributing factor, as defined on the previous page.

Three years of crash data, 2007 - 2009													
	Excessive Speed	Following Too Close	Fail to Yield ROW	Improper Maneuver	Inattention	Reckless or Careless	Aggressive	Fail to Stop	Parking Related	Vehicle Problem	Alcohol or Drugs	Hit and Run	**All Crashes**
Fatal	69	0	39	35	2	11	69	2	0	0	86	13	**151**
Injury A	350	267	499	246	70	113	564	391	7	12	136	49	**1,444**
Injury B	858	1,058	2,419	903	327	378	1,763	1,279	11	26	360	223	**5,720**
Injury C	2,357	6,834	4,136	2,289	849	478	8,325	7,510	50	50	448	906	**15,523**
PDO	4,685	10,447	8,985	8,561	1,264	636	13,733	11,571	302	147	770	1,361	**31,950**

Figure 7-1 presents the crash severity distribution of all crashes. Figure 7-2 presents the percentage of crashes of serious severity (fatal or injury A) with each contributing factor. Each crash may have several contributing factors.

Figures 7-1 and 7-2





Aggressive driving, defined as either excessive speed or following too close, is the most common contributing factor, contributing to 40% of the serious crashes in the region. Failure to yield, excessive speed, and failure to stop are the next three most common contributing factors.

Rear End Crashes

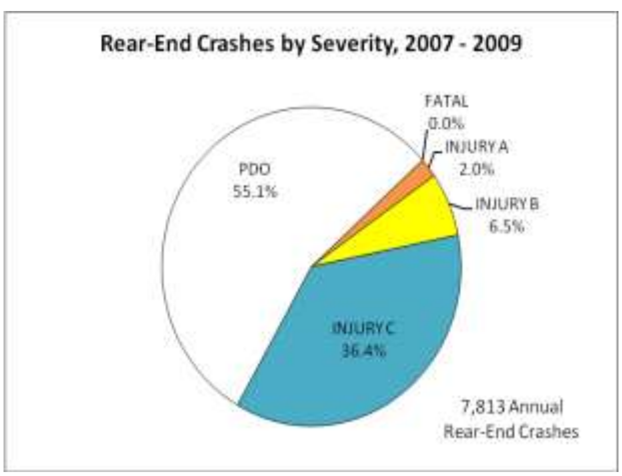
A Rear End crash results when a vehicle traveling in the same direction or parallel on the same path as another vehicle, collides with the rear end of a second vehicle. In this type, the direction of travel was parallel but continuous.

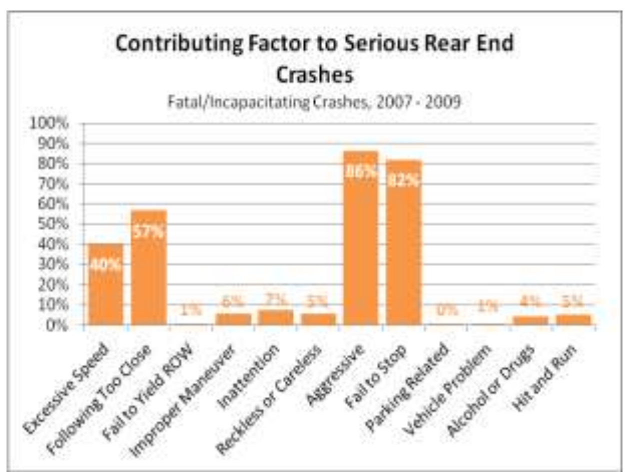
Rear End is the most common crash type in the region, as well as the most common serious crash type, although it is rarely fatal. Rear End crashes constitute 3% of fatal crashes, 29% of serious crashes, and 43% of all crashes in the region.

Three years of crash data, 2007 - 2009													
	Excessive Speed	Following Too Close	Fail to Yield ROW	Improper Maneuver	Inattention	Reckless or Careless	Aggressive	Fail to Stop	Parking Related	Vehicle Problem	Alcohol or Drugs	Hit and Run	**All Rear End Crashes**
Fatal	3	0	0	2	0	1	3	1	0	0	3	1	**5**
Injury A	183	263	4	24	34	24	398	379	1	4	16	22	**459**
Injury B	341	1,033	17	107	169	103	1,232	1,230	3	6	68	75	**1,521**
Injury C	1,620	6,655	37	478	677	248	7,481	7,304	6	24	168	497	**8,542**
PDO	2,490	10,095	72	837	852	175	11,341	10,855	17	21	166	369	**12,911**

Figure 7-3 presents the crash severity distribution of Rear End crashes. Figure 7-4 presents the percentage of Rear End crashes of serious severity (fatal or injury A) with each contributing factor. Each crash may have several contributing factors.

Figures 7-3 and 7-4





Rear End crashes are less severe than most crashes, producing a high proportion of injury C and PDO crashes. Aggressive driving is a factor in 86% of Rear End crashes. Failure to stop, following too closely, and excessive speed are all factors in a substantial proportion of Rear End crashes of serious severity.

Turning Crashes

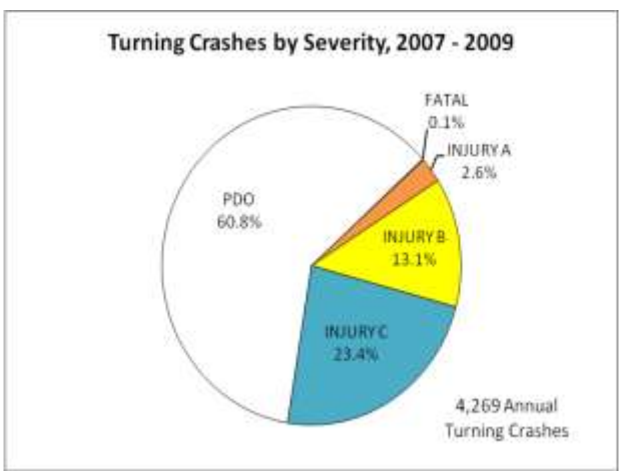
A Turning crash results when one or more vehicles in the act of a turning maneuver is involved in a collision with another vehicle. It differs from an Angle crash in that Turning crashes involve vehicles traveling on the same street, whereas Angle crashes involve vehicles traveling on intersecting streets or driveways.

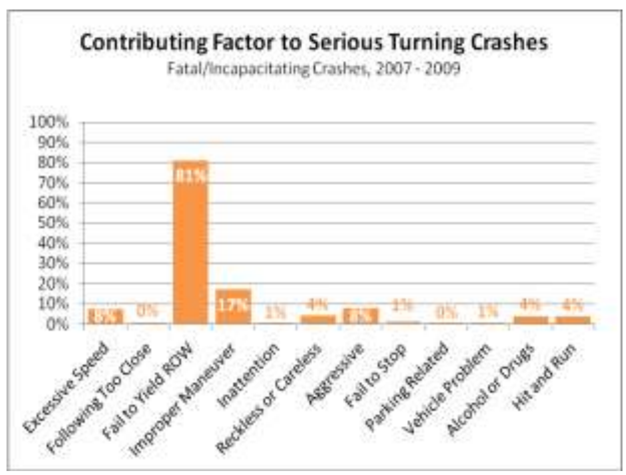
Turning is the second most common crash type in the region, as well as the second most common serious crash type. Turning crashes constitute 10% of fatal crashes, 22% of serious crashes, and 23% of all crashes in the region.

Three years of crash data, 2007 - 2009													
	Excessive Speed	Following Too Close	Fail to Yield ROW	Improper Maneuver	Inattention	Reckless or Careless	Aggressive	Fail to Stop	Parking Related	Vehicle Problem	Alcohol or Drugs	Hit and Run	**All Turning Crashes**
Fatal	4	0	11	3	0	1	4	0	0	0	4	2	**15**
Injury A	22	1	269	57	3	14	23	4	1	2	9	11	**331**
Injury B	52	13	1,354	246	12	54	59	17	0	2	45	41	**1,683**
Injury C	157	141	2,239	637	35	59	244	126	2	4	57	141	**2,995**
PDO	417	261	5,259	2,442	53	67	568	277	13	8	73	338	**7,781**

Figure 7-5 presents the crash severity distribution of Turning crashes. Figure 7-6 presents the percentage of Turning crashes of serious severity (fatal or injury A) with each contributing factor. Each crash may have several contributing factors.

Figures 7-5 and 7-6





Fixed Object Crashes

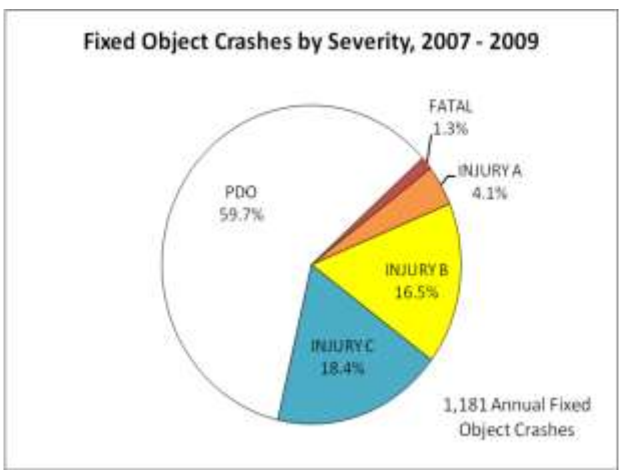
A Fixed Object crash results when one vehicle strikes a fixed or other object on or off the roadway.

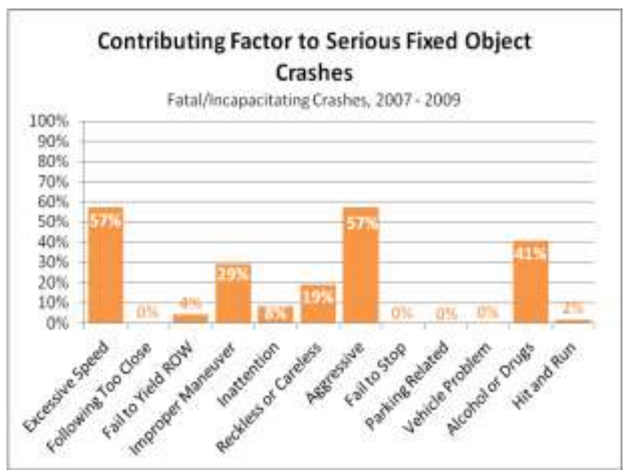
Fixed Object is the most common fatal crash type in the region. Fixed Object crashes constitute 31% of fatal crashes, 12% of serious crashes, and 6% of all crashes in the region.

Three years of crash data, 2007 - 2009													
	Excessive Speed	Following Too Close	Fail to Yield ROW	Improper Maneuver	Inattention	Reckless or Careless	Aggressive	Fail to Stop	Parking Related	Vehicle Problem	Alcohol or Drugs	Hit and Run	**All Fixed Object Crashes**
Fatal	36	0	4	14	1	3	36	0	0	0	33	0	**47**
Injury A	74	0	4	42	15	33	74	0	0	0	45	3	**145**
Injury B	289	4	5	187	72	93	291	7	2	8	129	21	**583**
Injury C	334	6	19	197	65	85	337	7	1	5	107	30	**653**
PDO	1,150	12	41	603	181	267	1,158	13	3	43	314	101	**2,116**

Figure 7-7 presents the crash severity distribution of Fixed Object crashes. Figure 7-8 presents the percentage of Fixed Object crashes of serious severity (fatal or injury A) with each contributing factor. Each crash may have several contributing factors.

Figures 7-7 and 7-8





Fixed Object crashes have a higher rate of severity including fatalities compared to other crash types. Speed, aggressive driving, and alcohol or drugs are often involved in Fixed Object crashes.

Pedestrian Crashes

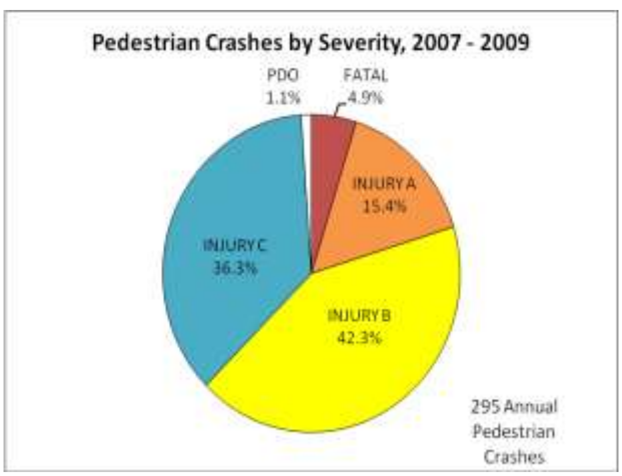
A Pedestrian crash results when the first harmful event is any impact between a motor vehicle in traffic and a pedestrian. It does not include any crash where a pedestrian is injured after the initial vehicle impact.

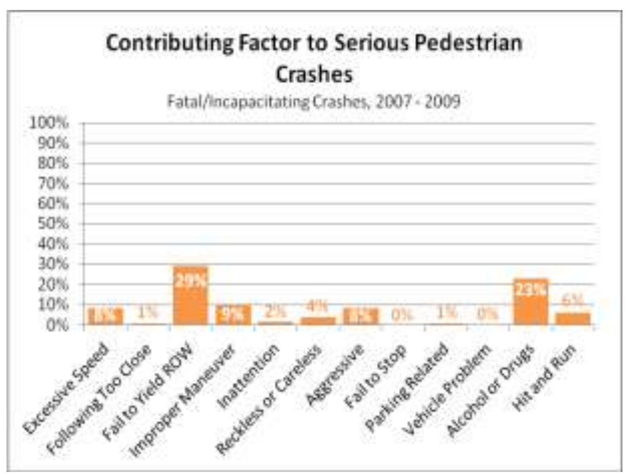
Pedestrian is the second most common fatal crash type in the region. Pedestrian crashes constitute 29% of fatal crashes, 11% of serious crashes, and 2% of all crashes in the region.

Three years of crash data, 2007 - 2009													
	Excessive Speed	Following Too Close	Fail to Yield ROW	Improper Maneuver	Inattention	Reckless or Careless	Aggressive	Fail to Stop	Parking Related	Vehicle Problem	Alcohol or Drugs	Hit and Run	**All Pedestrian Crashes**
Fatal	8	0	9	4	1	3	8	0	0	0	19	7	**43**
Injury A	7	1	43	13	2	4	7	0	1	0	22	4	**136**
Injury B	4	0	210	12	6	13	4	2	0	2	29	11	**374**
Injury C	5	0	202	13	6	4	5	1	0	0	28	11	**321**
PDO	1	0	7	1	0	0	1	0	0	0	0	0	**10**

Figure 7-9 presents the crash severity distribution of Pedestrian crashes. Figure 7-10 presents the percentage of Pedestrian crashes of serious severity (fatal or injury A) with each contributing factor. Each crash may have several contributing factors.

Figures 7-9 and 7-10





Pedestrian crashes have the highest severity of any crash type. Failure for the driver to yield right of way and alcohol or drug involvement are the two most coming contributing factors, although each is well below 50%.

Section 8 – Land Use Analysis

As part of the State of Safety report, Metro performed a spatial analysis of the crash, traffic, and land use patterns in the region. The purpose of the spatial analysis is to identify trends and patterns in serious crashes as they relate to land use patterns.

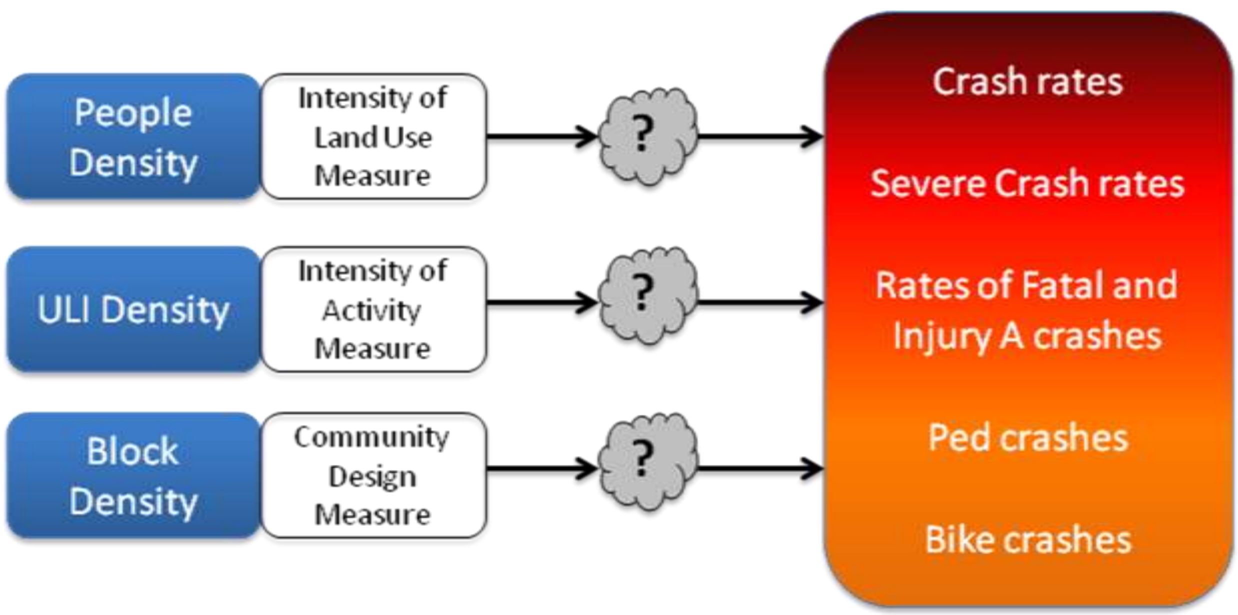
Methodology

The purpose of the spatial analysis was to relate land use characteristics to crash rates, which previously was an unknown relationship prone to extensive speculation. For this analysis, three land use measures were used: people density – a measure of intensity of use, the Urban Living Infrastructure (ULI) density – a measure of activity, and block density – a measure of community design.

People density is defined as the population plus employment per square mile. ULI density is defined as the number of qualifying service businesses (i.e. grocery stores, restaurants, coffee shops, theaters) per square mile. Block density is defined as the number of street blocks per square mile, and can also be considered a measure of density of streets and intersections.

Figure 8-1 depicts the relationship that this analysis was intended to clarify.

Figure 8-1



Spatial Data

For the spatial analysis, the Metro Region was divided into 39,917 spatial analysis “cells”, each comprising one hundredth (0.01) of a square mile. Each cell was populated with land use and traffic data.

The land use data included:

- People Density – Total population plus employment present
- ULI Density – An activity measure, the quantity of service-related businesses present
- Block Density – A measure of the density of streets and intersections

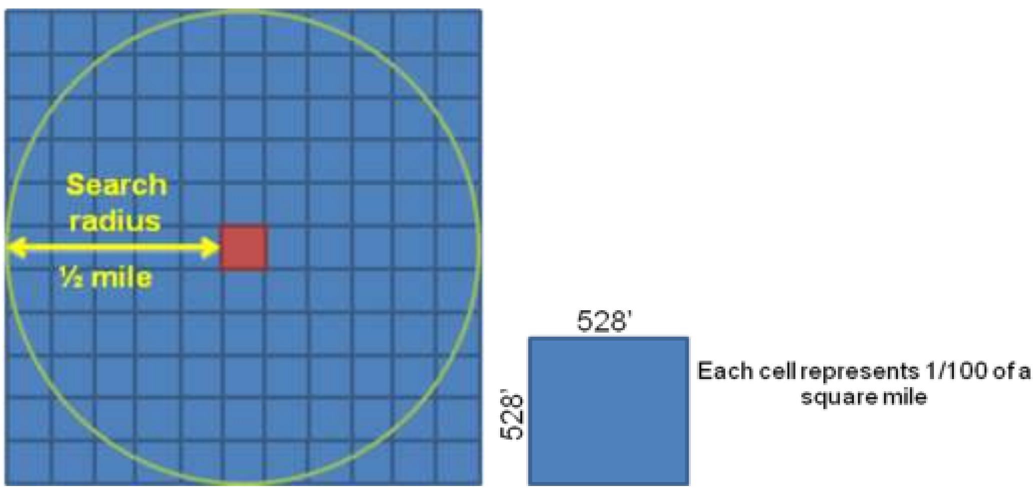
The traffic data included:

- Traffic volume – Relative number of vehicles
- Transit ons+offs – Number of TriMet passengers boarding or alighting
- Number of crashes – Number of reported vehicle-involved crashes
- Severity-weighted number of crashes – Weighted number of crashes, where fatal and injury A get 100 points, and injury B and C get 10 points
- Number of fatal and injury A crashes
- Number of reported vehicle-pedestrian crashes
- Number of reported vehicle-bicycle crashes

Search Method: land use data

Because each analysis cell is fine-grained, many comprise a single land parcel or less, and many include no streets or development whatsoever. To get a better picture of the land use characteristics around each analysis cell, it was important to identify not just the land use pattern within the 0.01-square mile cell, but also the influence of the land use patterns within a vicinity of the cell. To do this, a search method was employed to measure land use data relative to the area around it. Land use patterns within one-half mile were considered as the pertinent land use data for each cell. Each cell is informed by the data in the cells around it. This process was repeated for every cell in the region, so that the land use information "overlaps" as we move from one cell to the next. Figure 8-2 depicts the land use search method.

Figure 8-2



The search method allows us to measure land use of a given area on a cell-specific basis, and avoids the erratic data that would result if we looked only within an individual cell, which in most cases would be small number of parcels, and in some cells would be entirely vacant. It measures the land use within a ½ mile radius for each cell, thereby providing a consistent measure of land use.

Figures 8-3, 8-4, and 8-5 present the people density, ULI density, and block density for the region based on this methodology.

Figure 8-3

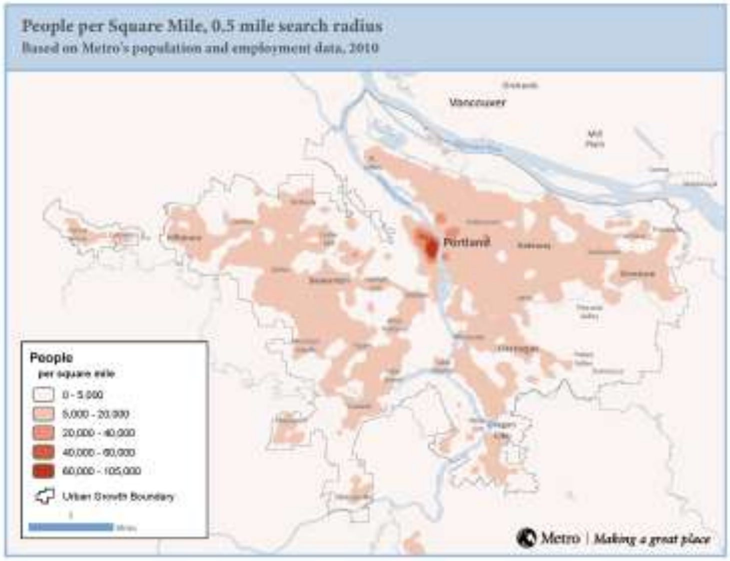


Figure 8-4

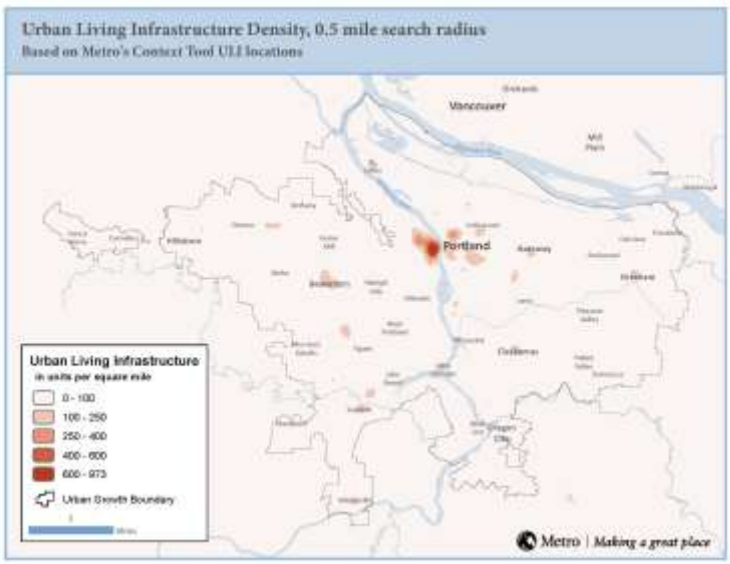
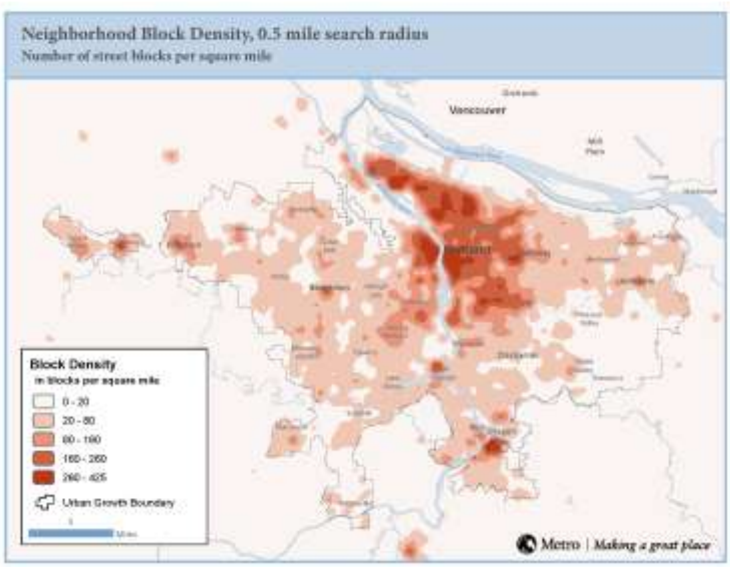


Figure 8-5



Search Method: traffic data

A similar process was undertaken for traffic-related data. The key difference is that traffic data generally exist in linear patterns – along roadways, rather than spatially like land use data. In order to relate traffic data and land use data, traffic data were converted into spatial data for use in analysis cells.

For each analysis cell, it was important to identify not just traffic patterns within the 0.01-square mile cell, but also the influence of traffic patterns within a vicinity of the cell. A search method similar to that used for land use data was employed to measure traffic data relative to the area around it. Traffic patterns within one-and-one-half (1-½) miles were considered as the pertinent traffic data for each cell. A larger search area was used based on the need to distribute arterial traffic across the neighborhoods they traverse. Since arterials carry a large portion of regional traffic and constitute the majority of crashes, a smaller search area simply identified neighborhoods along arterials as crash-prone. Since arterial spacing throughout the region is typically between ¾ mile and 1-½ miles, the use of a 1-½ mile search radius eliminated the arterial influence bias, distributing traffic and crash patterns across the neighborhoods which influence traffic patterns on the arterials and other roadways. The cell traffic data are therefore a function of the neighborhoods in the vicinity *including* the arterials which area residents and employees would likely use on a regular basis.

As with the land use data, each cell is informed by the traffic data in the cells around it. This process was repeated for every cell in the region, so that the land use information "overlaps" as we move from one cell to the next. Figure 8-6 depicts the traffic search method.

Figure 8-6

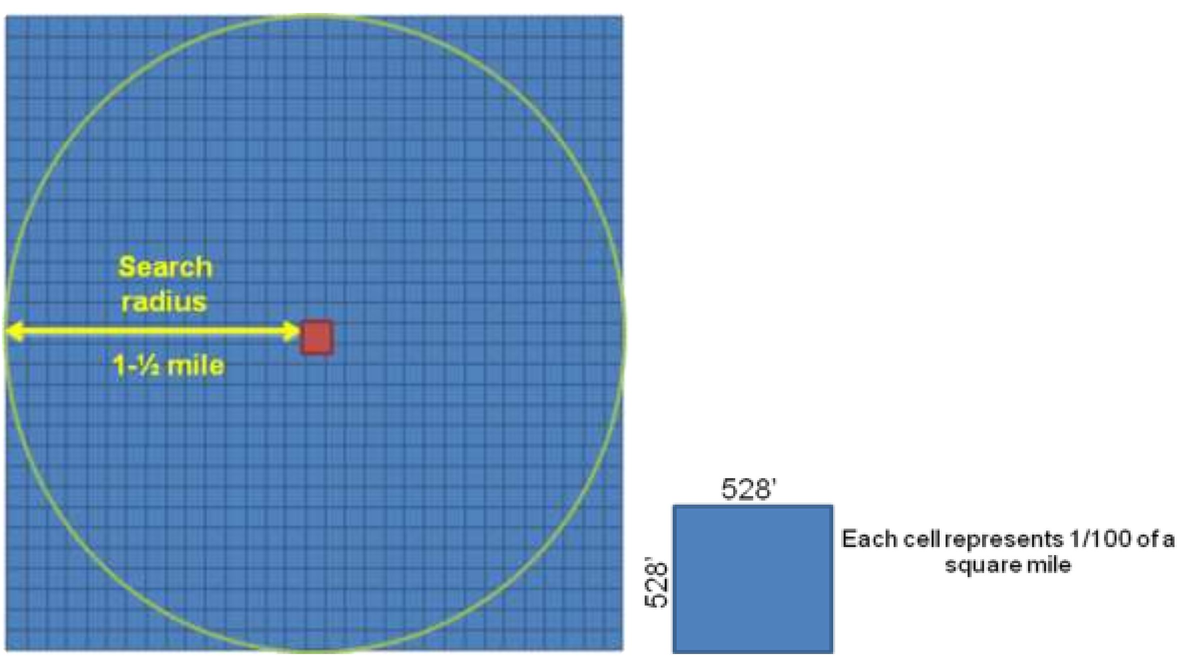
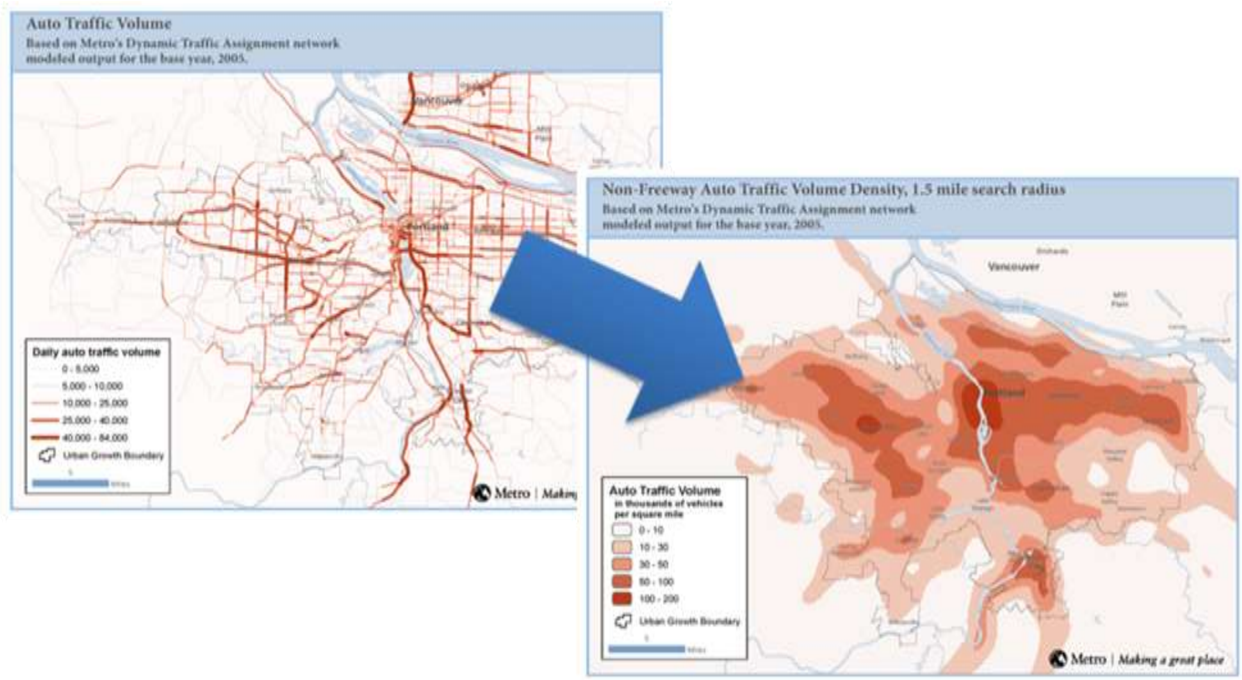


Figure 8-7 presents the conversion of linear traffic data into spatial traffic data, using traffic volume as an example.

Figure 8-7



Linear traffic volumes were converted into a spatial traffic density layer. Pedestrian activity and crashes by type were spatially distributed in the same way.

Figures 8-8 through 8-11 compare traffic volume distribution based on varying search radii. As can be seen from the figures, search radii of less than 1-½ miles leave a pronounced bias in neighborhoods proximate to arterials roadways.

Figure 8-8: Linear

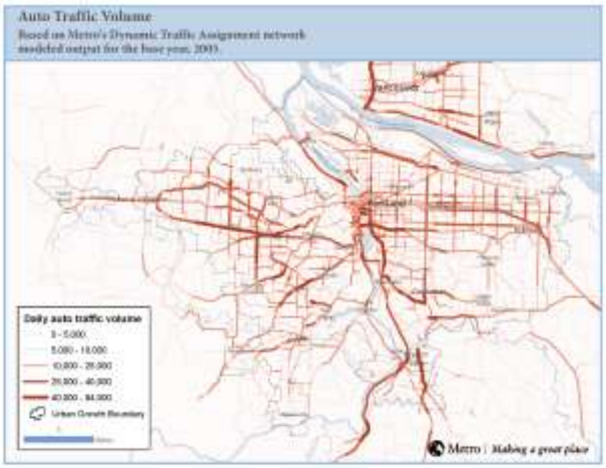


Figure 8-9: ½ mile search radius

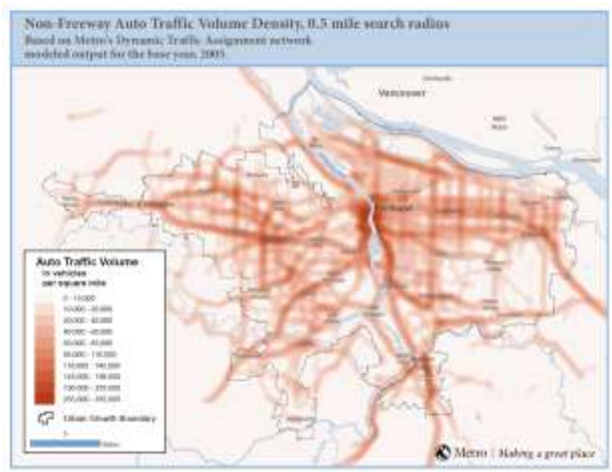


Figure 8-10: 1 mile search radius

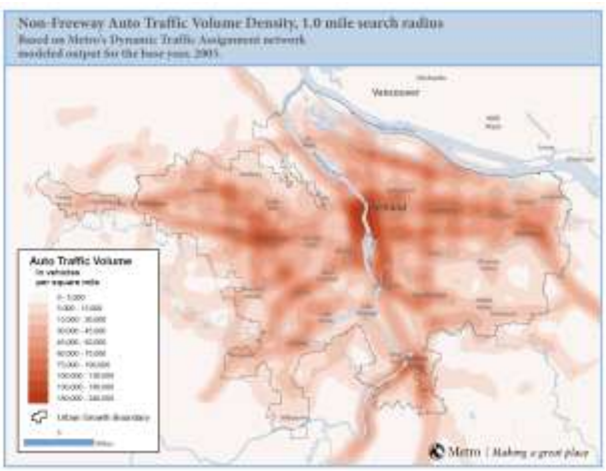
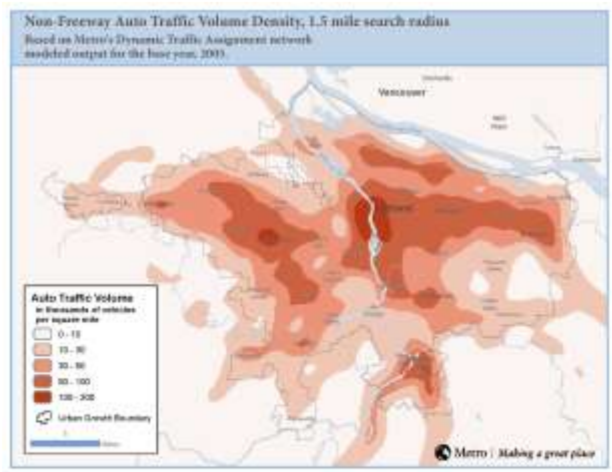


Figure 8-11: 1-½ mile search radius

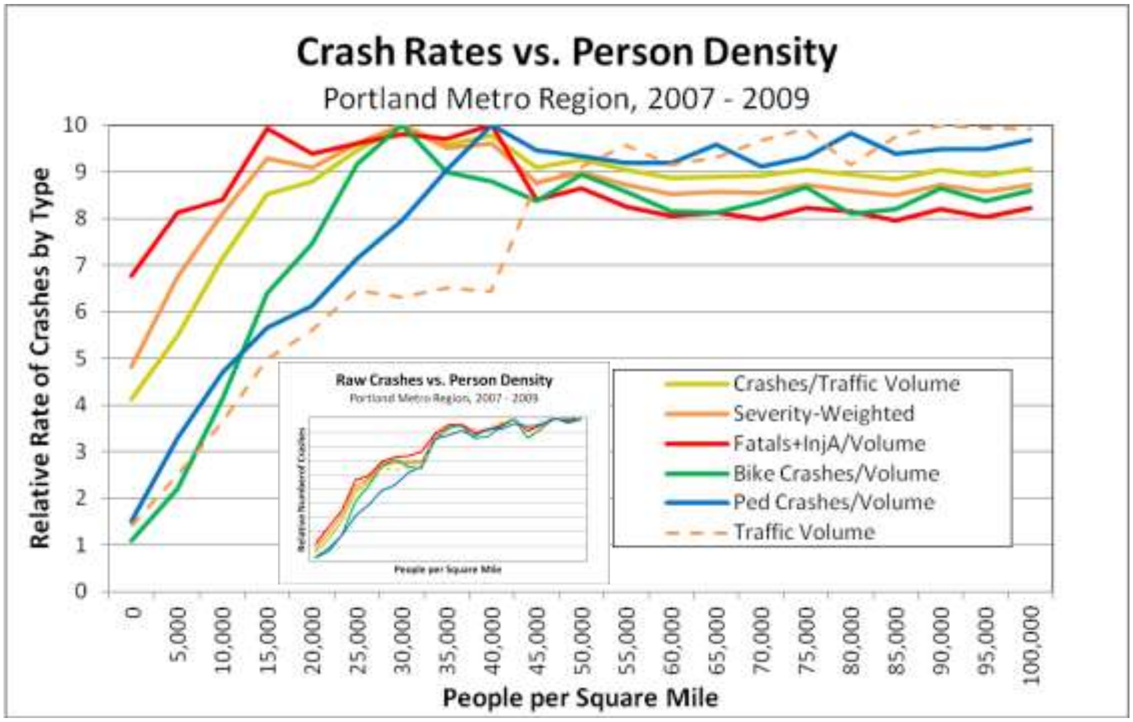


The 1-½ mile search radius was selected for spatial traffic data based upon these maps in order to avoid the arterial roadway bias.

Person Density

Figure 8-12 presents the relationship between crash rates and person density. Background traffic volume is indicated by the dashed line. The inset presents the same information for *raw numbers of crashes* rather than for *crash rates*.

Figure 8-12



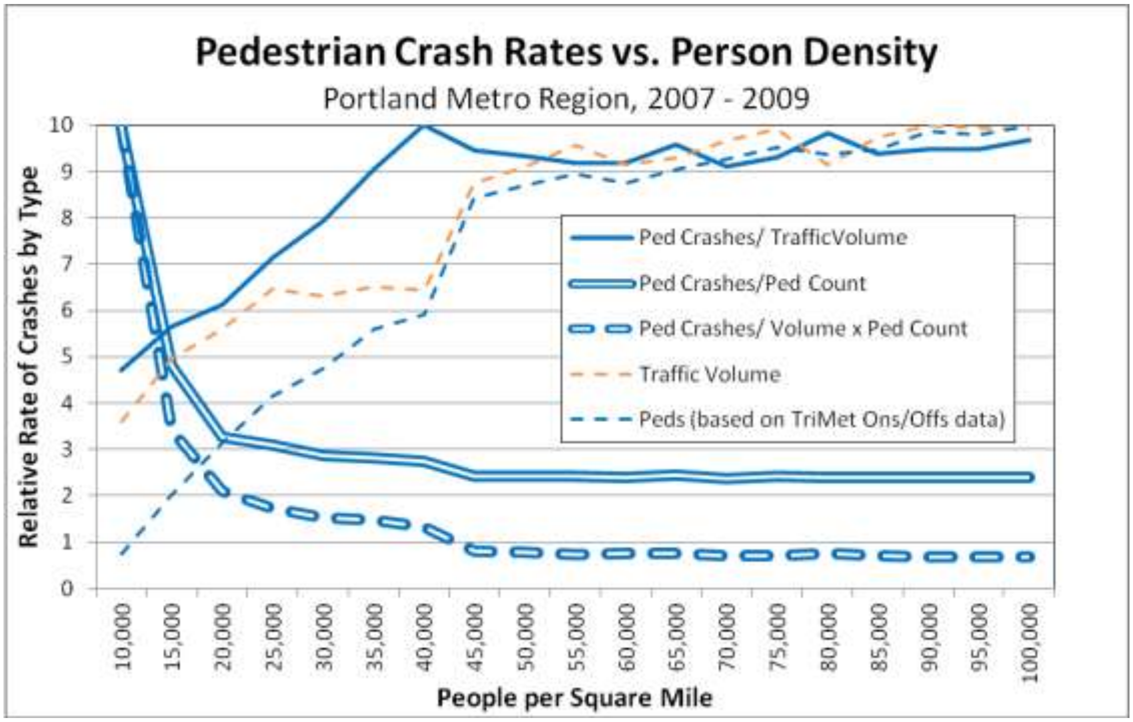
Crash rates are per traffic volume, and are normalized on a ten-point scale for ease of representation.

The analysis indicates some trends:

- **Crash rates** increase with increasing people density, peaking in the 15,000 – 40,000 people per square-mile range, then drop slightly and level off with increasing people density.
- **Serious crashes** (fatal and incapacitating crashes) are a higher proportion of overall crashes at lower people densities than they are at higher people densities.
- **Pedestrian crashes and bicycle crashes** both follow the overall trend of increasing with people density to a point, then leveling off.

Figure 8-13 presents the relationship between pedestrian crash rates and person density. Background traffic volume and pedestrian volume (estimated from TriMet boarding data) are indicated by the dashed lines.

Figure 8-13



Three pedestrian crash rates are presented: per traffic volume, per pedestrian volume, and per the product of traffic and pedestrian volumes. Each rate is normalized on a ten-point scale for ease of representation.

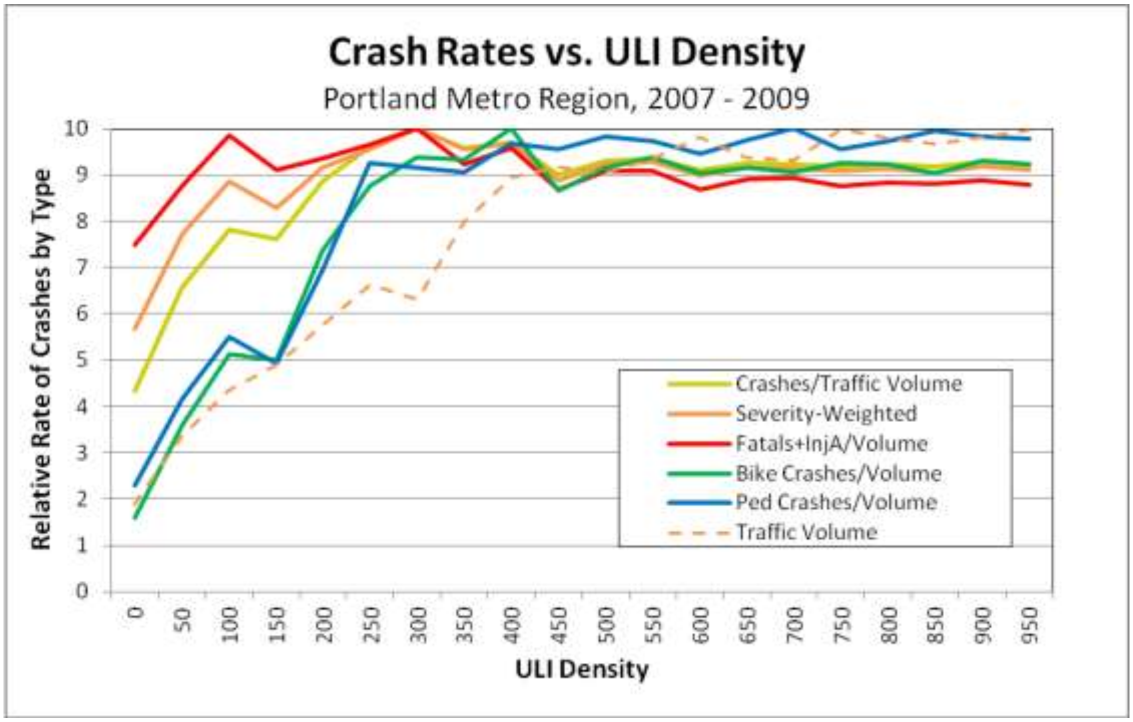
The analysis indicates some trends:

- **Pedestrian crashes per motor vehicle traffic volume** increases with increasing people density, peaking in the 40,000 – 45,000 people per square-mile range, then level off with increasing people density.
- **Pedestrian crashes per pedestrian volume** decreases rapidly with increasing people density to about 50,000 people per square-mile, then levels off.

Activity Density

Figure 8-14 presents the relationship between crash rates and urban living infrastructure (ULI) density. Background traffic volume is indicated by the dashed line.

Figure 8-14



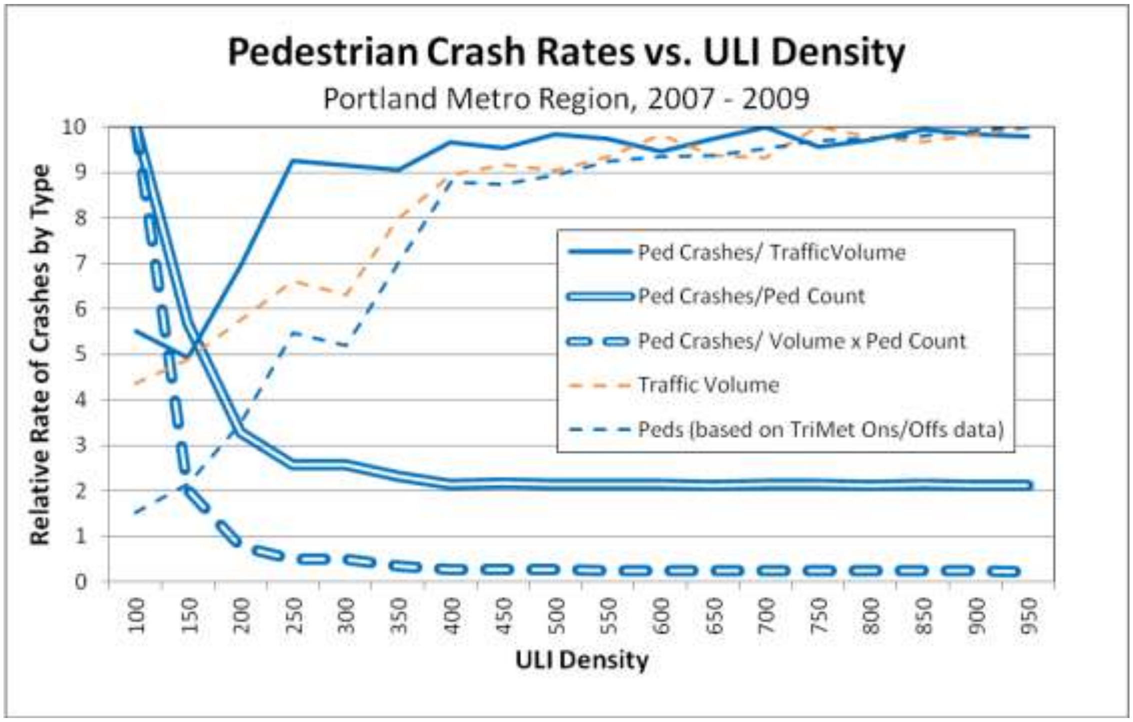
Crash rates are per traffic volume, and are normalized on a ten-point scale for ease of representation.

The analysis indicates some trends:

- **Crash rates** increase with increasing ULI density, peaking in the 250 – 450 ULI businesses per square-mile range, then drop slightly and level off with increasing ULI density.
- **Serious crashes** (fatal and incapacitating crashes) are a higher proportion of overall crashes at lower ULI densities than they are at higher ULI densities.
- **Pedestrian crashes and bicycle crashes** both follow the overall trend of increasing with ULI density to a point, then leveling off.

Figure 8-15 presents the relationship between pedestrian crash rates and ULI density. Background traffic volume and pedestrian volume (estimated from TriMet boarding data) are indicated by the dashed lines.

Figure 8-15



Three pedestrian crash rates are presented: per traffic volume, per pedestrian volume, and per the product of traffic and pedestrian volumes. Each rate is normalized on a ten-point scale for ease of representation.

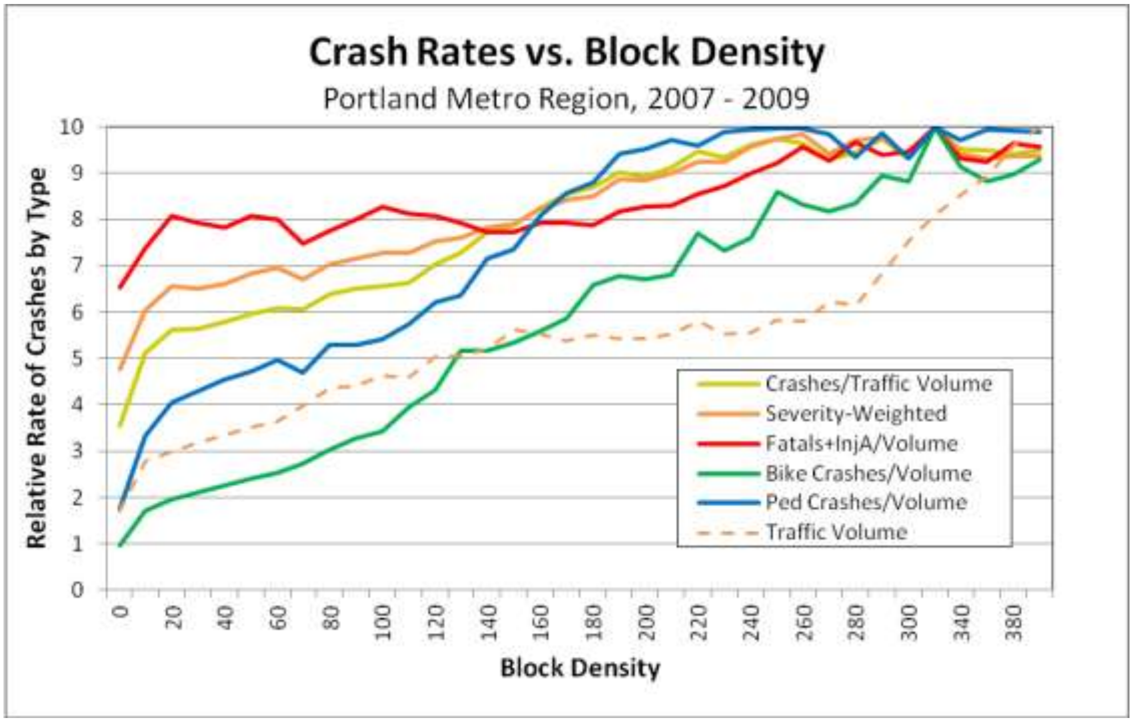
The analysis indicates some trends:

- **Pedestrian crashes per motor vehicle traffic volume** increases with increasing ULI density, peaking in the 250 ULI businesses per square-mile range, then level off with increasing ULI density.
- **Pedestrian crashes per pedestrian volume** decreases with increasing ULI density to about 450 ULI businesses per square-mile, then levels off.

Neighborhood Form

Figure 8-16 presents the relationship between crash rates and block density. Background traffic volume is indicated by the dashed line.

Figure 8-16



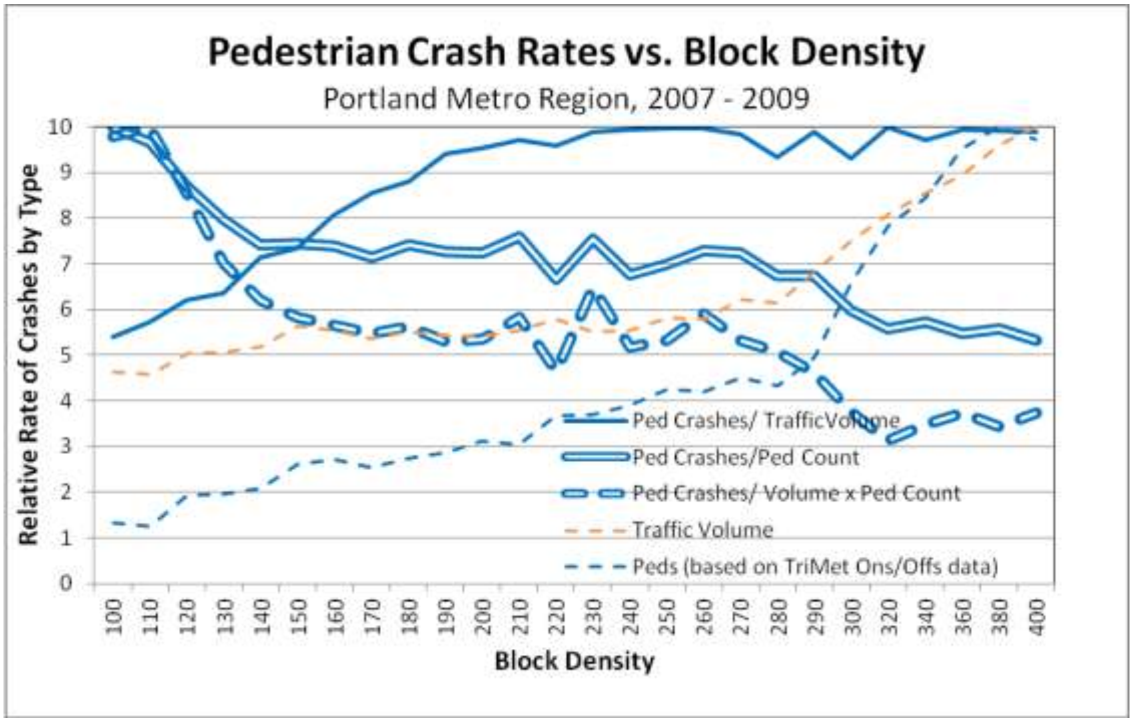
Crash rates are per traffic volume, and are normalized on a ten-point scale for ease of representation.

The analysis indicates some trends:

- **Crash rates** increase with increasing block density.
- **Serious crash rates** (fatal and incapacitating crashes) increase with increasing block density, but less so than total crash rates.
- **Pedestrian crashes and bicycle crashes** increase with increasing block density.

Figure 8-17 presents the relationship between pedestrian crash rates and block density. Background traffic volume and pedestrian volume (estimated from TriMet boarding data) are indicated by the dashed lines.

Figure 8-17



Three pedestrian crash rates are presented: per traffic volume, per pedestrian volume, and per the product of traffic and pedestrian volumes. Each rate is normalized on a ten-point scale for ease of representation.

The analysis indicates some trends:

- **Pedestrian crashes per motor vehicle traffic volume** increases with increasing block density, peaking in the 230 – 270 blocks per square-mile range, then level off with increasing block density.
- **Pedestrian crashes per pedestrian volume** decreases with increasing block density.

Interrelationships

It is important to acknowledge that the three land use variables considered are not independent from one another, nor or they independent from traffic volume or pedestrian activity.

Figures 8-18, 8-19, and 8-20 present the interrelationship of the land use variables considered.

Figure 8-18

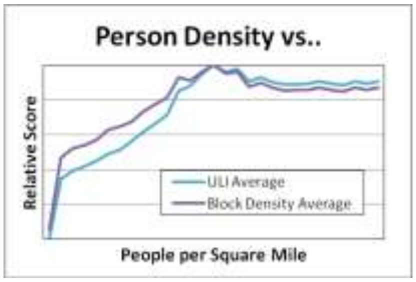


Figure 8-19

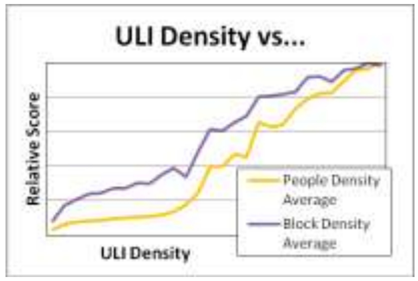


Figure 8-20

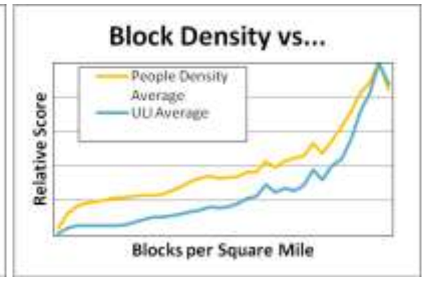


Figure 8-21 presents the relationship between traffic volume and crashes by severity. Figure 8-22 presents the relationship between transit boardings (a measure of relative pedestrian activity) and pedestrian and bicycle crashes.

Figure 8-21

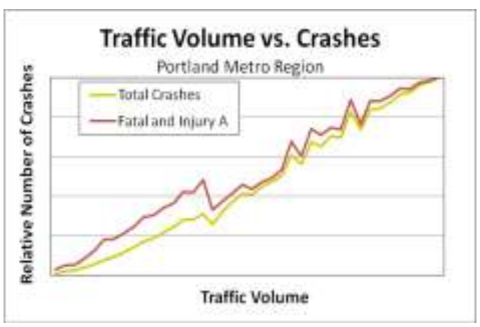
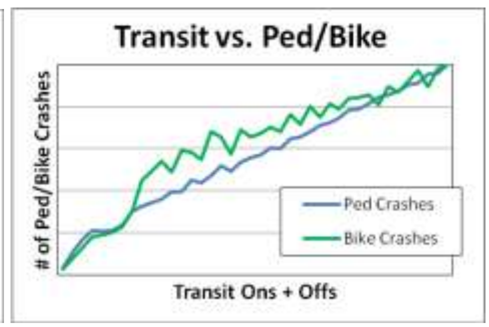


Figure 8-22



It is clear that people density, activity, and block density are all related. It is also clear that increases in traffic volume and pedestrian activity are associated with increasing densities. Finally, it is clear that increasing crashes are associated with increases in any of these related factors.

One clear relationship, both from the regional data in Figure 8-21 and from the national data in Figure 1-7, is that increases in traffic volumes (and hence vehicle miles travelled) are correlated with an increase in serious crashes.

Data Limitations

While the spatial analysis produces useful results, some limitations of the analysis should be acknowledged.

The first limitation is the poor distribution of land use typology in the region, in that the majority of the region, by area, is at the lowest end of the density scale in each of the categories. For example:

- 98% of cells are in lowest 3 of 21 people density ranges.
- 98% of cells are in lowest 2 of 20 ULI density ranges.
- 66% of cells are in lowest 5 of 36 block density ranges.

Most of the higher ranges of people and ULI density cells are in downtown Portland and inner NW Portland, which limits consideration of those densities to one specific area.

The second limitation is the data smoothing process that the search method for land use and traffic data introduces. While this smoothing is necessary to make real-world data usable, it dampens relationships and makes concluding anything meaningful about local crash risk factors difficult.

Another limitation is the coarse classification of urban form. ULI density, for example, can take a highly urban form, like the shopping around Pioneer Square, but it can also be an arterial strip use. Since most places have more of the latter, the variable is almost certainly going to be positive with crashes.

Despite the real data limitations, trends are still apparent in the data. The large number of data points – 39,917 cells – means that even the 2% of the cells in the upper 19 people density ranges – 798 cells – is a significant enough number to produce noticeable trends. The same holds true for ULI density and block density. While smoothing may dampen trends, they are still discernible. Conclusions are more difficult to establish given these limitations.

Section 9 – Transit and Rail

This section provides an overview of the crash data available for bus and rail transit and heavy rail in the Portland Metro region.

Data Sources

The statewide crash data used for Sections 2 through 8 includes all crashes in which a motor vehicle was involved. It does include train-vehicle crashes, but does not include train-bicycle or train-pedestrian crashes, and it does not distinguish transit bus crashes from other bus types. Additional data were sought to provide an overview of crash patterns for bus and rail transit and heavy rail systems.

Transit

TriMet, the transit provider for the three-county region including most of the Metro region, provided their crash database for use in this report. It summarizes incidents on TriMet fixed route buses and light rail vehicles, and identifies when a known injury was involved. It does not distinguish between injury types. TriMet also provided information on crashes with TriMet vehicles involved resulting in a fatality.

The following table summarizes the data for 2007 through 2009 and compares TriMet's safety performance to that of all vehicles in the Portland Metro region.

	TriMet Buses	TriMet Light Rail	TriMet Overall	All vehicle on public roads
Total passenger fatalities	0	0	0	104
Total other people fatalities	0	3*	3	55
100 Million Vehicle-miles	0.788	0.116	0.905	279
100 Million Passenger-miles	6.987	5.862	12.850	383
Average number of passengers	8.9	50.4	14.2	1.37
Total Fatalities per 100 Million Vehicle-miles	0.00	25.79	3.32	0.57
Total Fatalities per100 Million Passenger-miles	0.00	0.51	0.23	0.42

* Excludes one fatality determined to be a suicide.

Rail

The Federal Railroad Administration (FRA) provides access to national crash records involving heavy rail trains on their website. The following table summarizes the crashes reported at non-transit rail grade crossings in the Portland Metro region between 2007 and 2009, via FRA's database. It does not include crashes occurring at locations other than grade crossings.

		Crossing Type		Road vehicle type				
	Total	Public	Private	Car	Truck	Ped	Bike	Other
Number of crashes	15	8	7	9	4	1	0	1
Injury crashes	1	1	0	0	0	1	0	0
Fatal crashes	0	0	0	0	0	0	0	0

The only recorded injury was a pedestrian struck on State Street in downtown Lake Oswego.

Section 10 – Findings and Strategies

This section presents high-level findings, focusing on trends that are clearly apparent from the data.

- Nationally and in Oregon, fatalities are decreasing year-to-year for all modes except motorcycle, which is increasing.
- Higher levels of vehicle miles travelled (VMT) correlate with more fatal and serious crashes due to increased exposure.
- Arterial roadways comprise 59% of the region's serious crashes, 67% of the serious pedestrian crashes, and 52% of the serious bike crashes, while accounting for 40% of vehicle travel. Arterials have the highest serious crash rate per road mile and per VMT.
- Streets with more lanes have higher serious crash rates per road mile and per VMT. This follows trends documented in AASHTO's Highway Safety Manual.
- Streets with more lanes have an especially high serious crash rate for pedestrians, producing higher crash rates per mile and per VMT as compared to other modes.
- The most common serious crash types were Rear End and Turning. For fatal crashes, the most common types were Pedestrian and Fixed Object.
- Alcohol or drugs were a factor in 57% of fatal crashes.
- Speed is a contributing factor in 26% of serious crashes, while aggressive driving is a factor in 40% of serious crashes.
- Aggressive driving was a factor in 86% of serious Rear End crashes.
- Occupants without seat belts were three times as likely to be seriously injured in a crash as those with seat belts.
- Serious pedestrian crashes are disproportionately represented after dark. While 29% of all serious crashes happen at night, 45% of serious pedestrian crashes happen at night.
- Nighttime serious pedestrian and bicycle crashes occur disproportionately where street lighting is not present. 79% of serious pedestrian crashes and occurring at night and 85% of serious bicycle crashes occurring at night happen where lighting is not present, as compared to 18% of all serious crashes occurring at night.
- Higher levels of congestion on surface streets appear to result in lower serious crash rates across modes, likely due to lower speeds.
- Higher levels of congestion on freeways appear to result in higher serious crash rates, except for severe congestion, which results in lower serious crash rates, likely due to lower speeds.
- Travel by transit is relatively safe, with no passenger deaths in the study period, and 0.23 deaths involving a transit vehicle per 100-million-transit-passenger-miles. For comparison, the rate for all traffic was 0.42 deaths per 100-million-motor-vehicle-passenger -miles.
- Portland, with 39% of the region's population, is disproportionately represented per capita, with 43% of the region's serious crashes, 56% of the region's serious pedestrian crashes, and 68% of the region's serious bicycle crashes.
- Unincorporated Multnomah and Clackamas Counties, and cities of Clackamas County have the highest serious crash rates. These tend to be developing areas or areas with an incomplete street network.

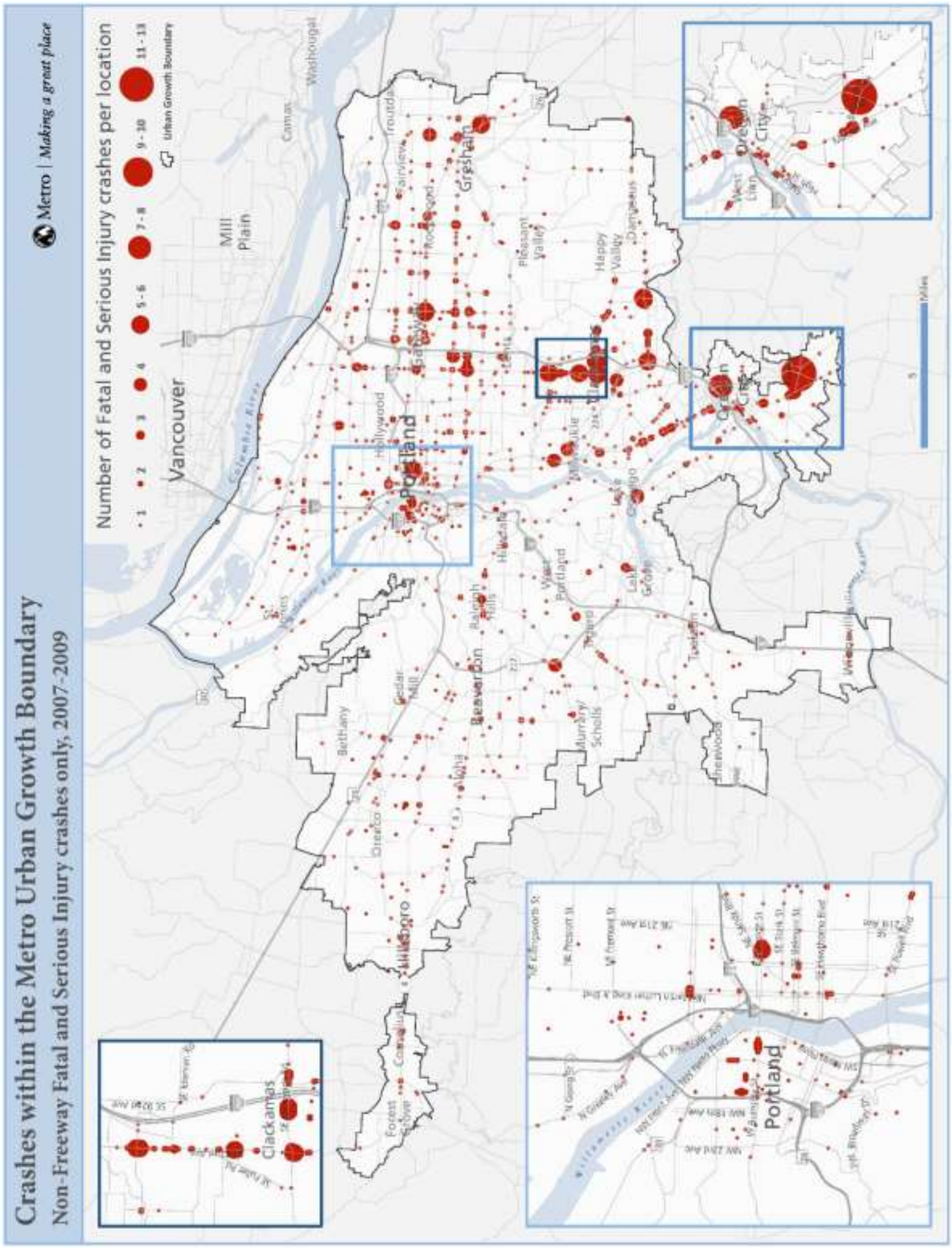
- Portland, Gresham, Cornelius, Tigard, unincorporated Clackamas County, Tualatin, and Hillsboro and Oregon City exhibit the highest rates of serious pedestrian crashes per capita in the region.
- Portland, Gresham, Tigard, and Oregon City exhibit the highest rates of serious bicycle crashes per capita in the region.
- The range of land use densities in the region was not enough to conclusively establish relationships with safety. However, it is clear that increasing densities result in increased activity and traffic volumes, leading to generally higher crash rates. More research is needed to establish reliable relationships with land use.

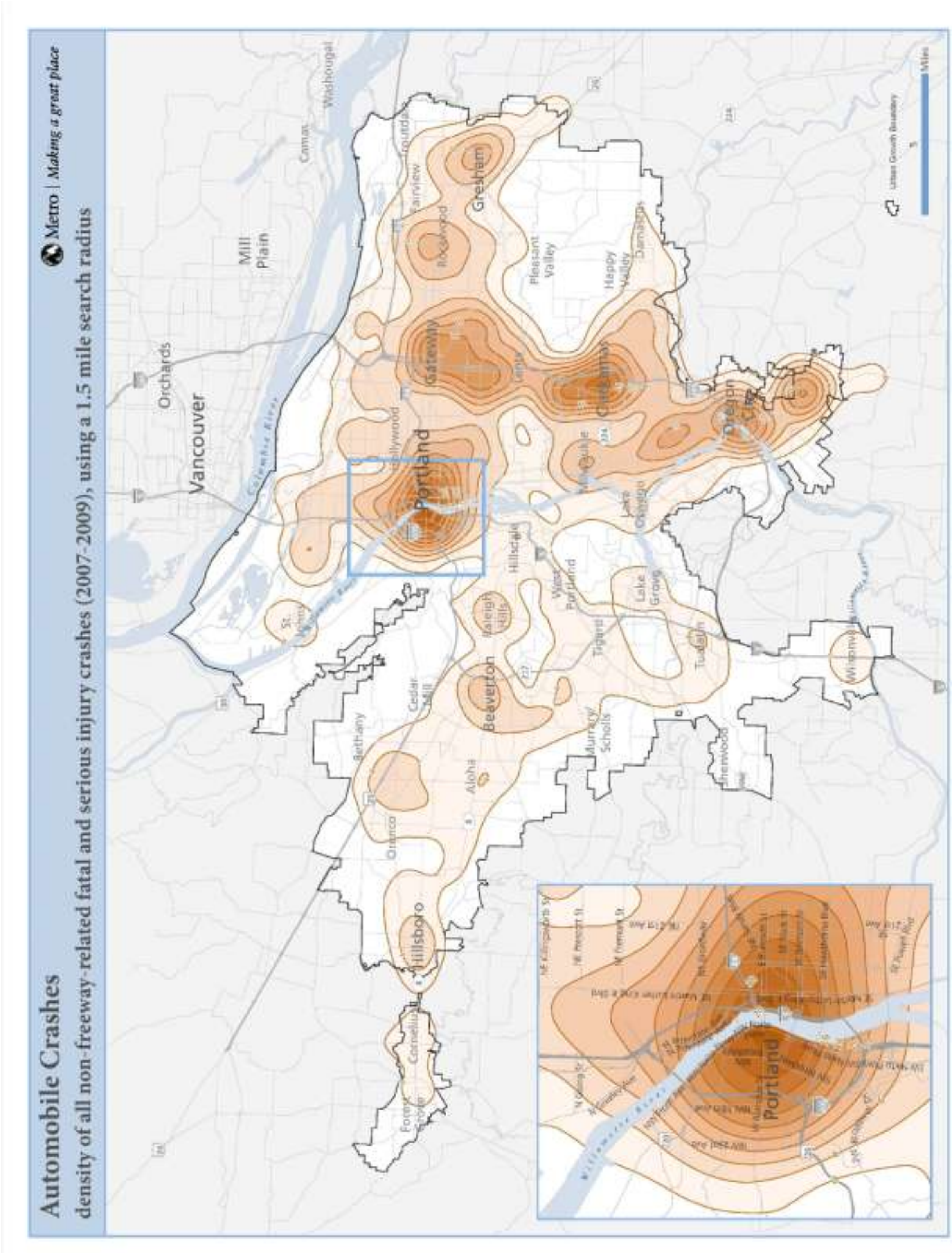
The Regional Transportation Plan calls for a 50% reduction in fatalities plus serious injuries for pedestrians, bicyclists, and motor vehicle occupants by 2035 as compared to 2005. Strategies for implementation should include:

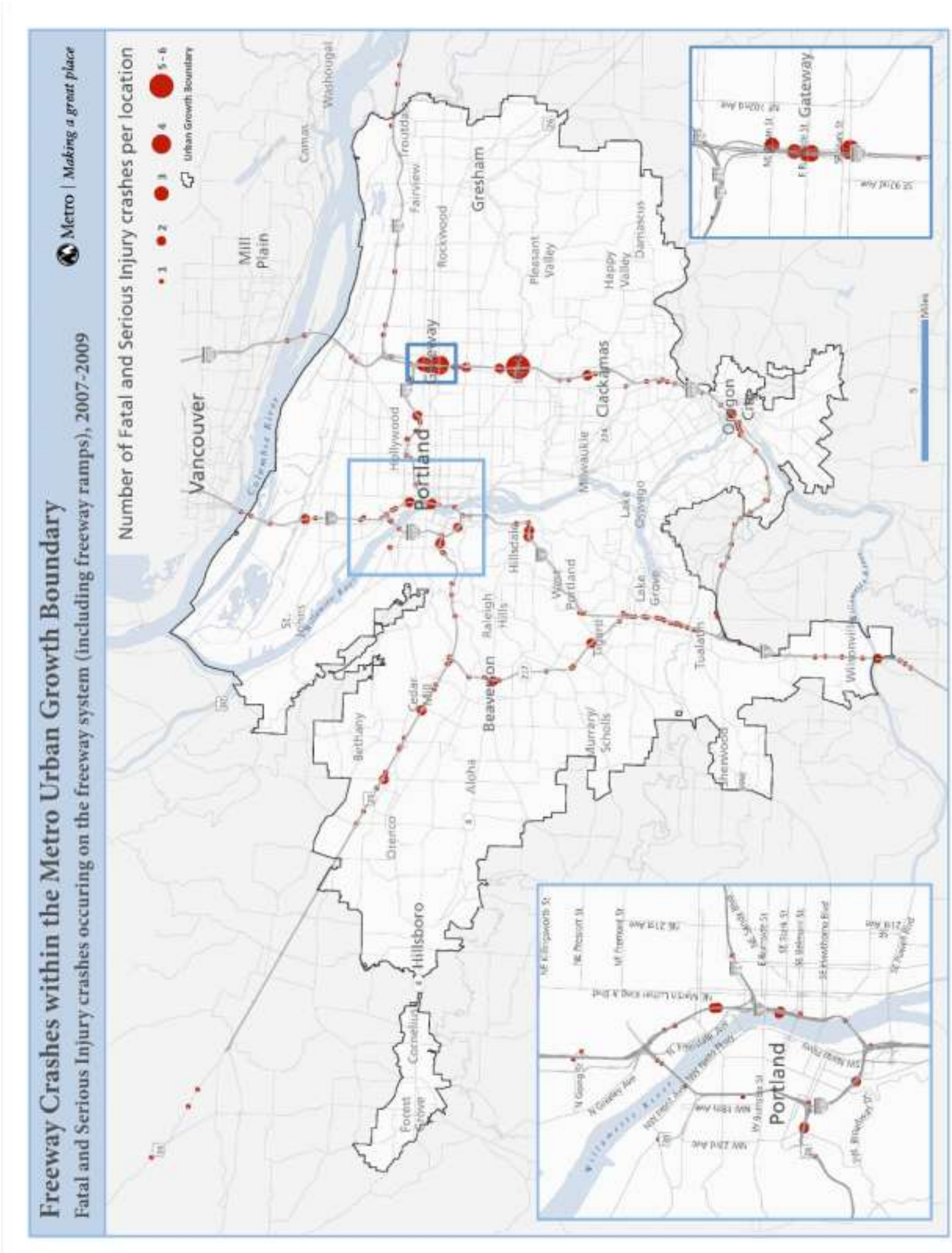
- A regional arterial safety program to focus on corridors with large numbers of serious crashes, pedestrian crashes, and bicycle crashes
- Safety strategies that match solutions to the crash pattern and street and neighborhood context, rather than an approach of simply bringing roadways up to adopted standards
- Highway Safety Manual strategies to address arterials, such as medians, speed management, access management, roundabouts, and road diets
- Policies that reduce the need to drive, and therefore limit vehicle-miles travelled
- Strategies to reduce the prevalence of speeding and aggressive driving on surface streets
- Strategies to reduce the use of alcohol and drugs when driving
- Revisions to state, regional, and local mobility standards to consider safety as equally important, at a minimum, as vehicular capacity
- A focus on crosswalk and intersection lighting where pedestrian activity is expected
- Policies to improve the quality and frequency of pedestrian crossings on arterials and multi-lane roadways
- A focus on safe cycling facilities and routes, particularly in areas where serious crashes are occurring
- More detailed analysis of the causes of serious crashes, pedestrian crashes, and bicycle crashes in the region
- More detailed research on the relationship between land use patterns and safety

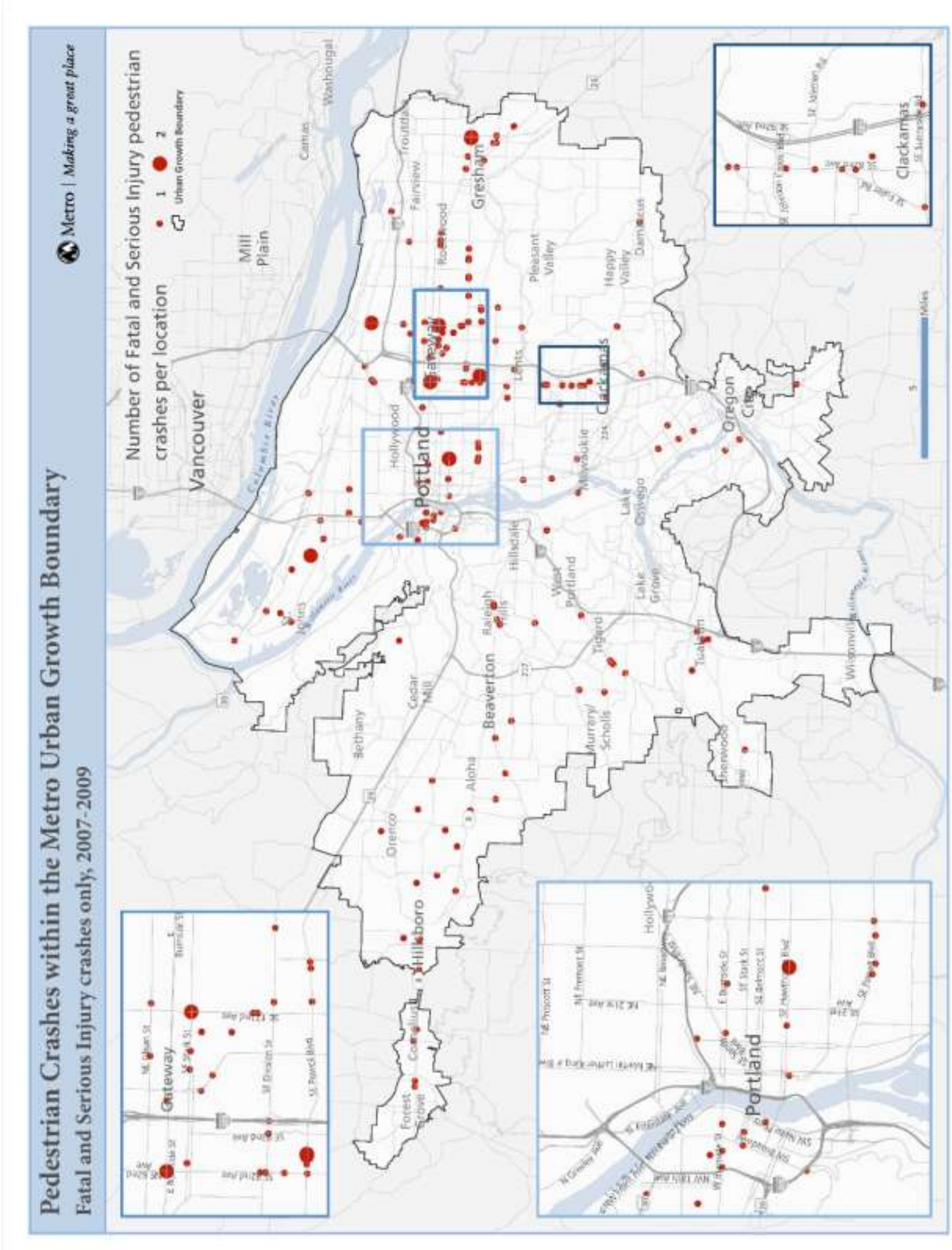
Appendix: Maps

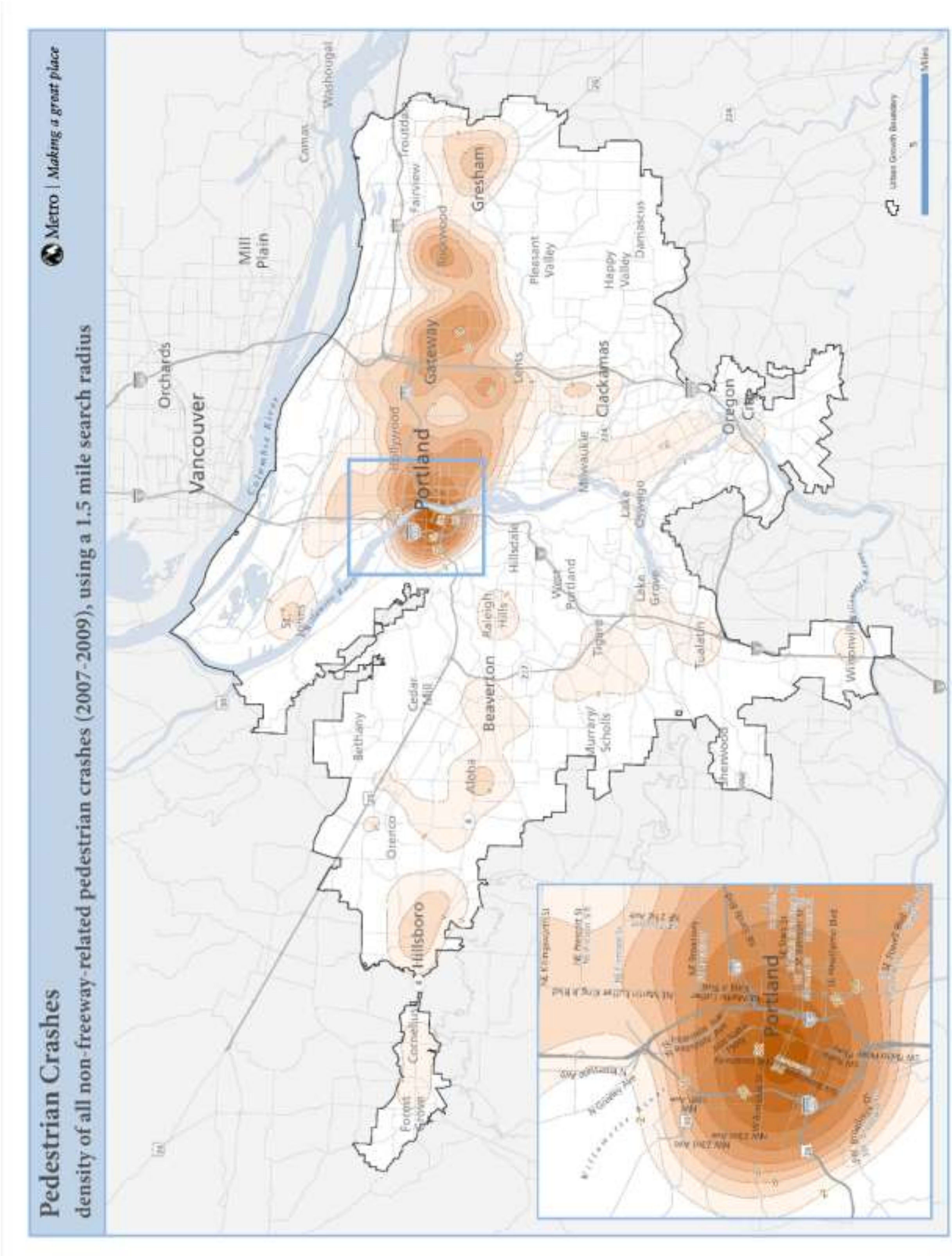
Listing of Maps

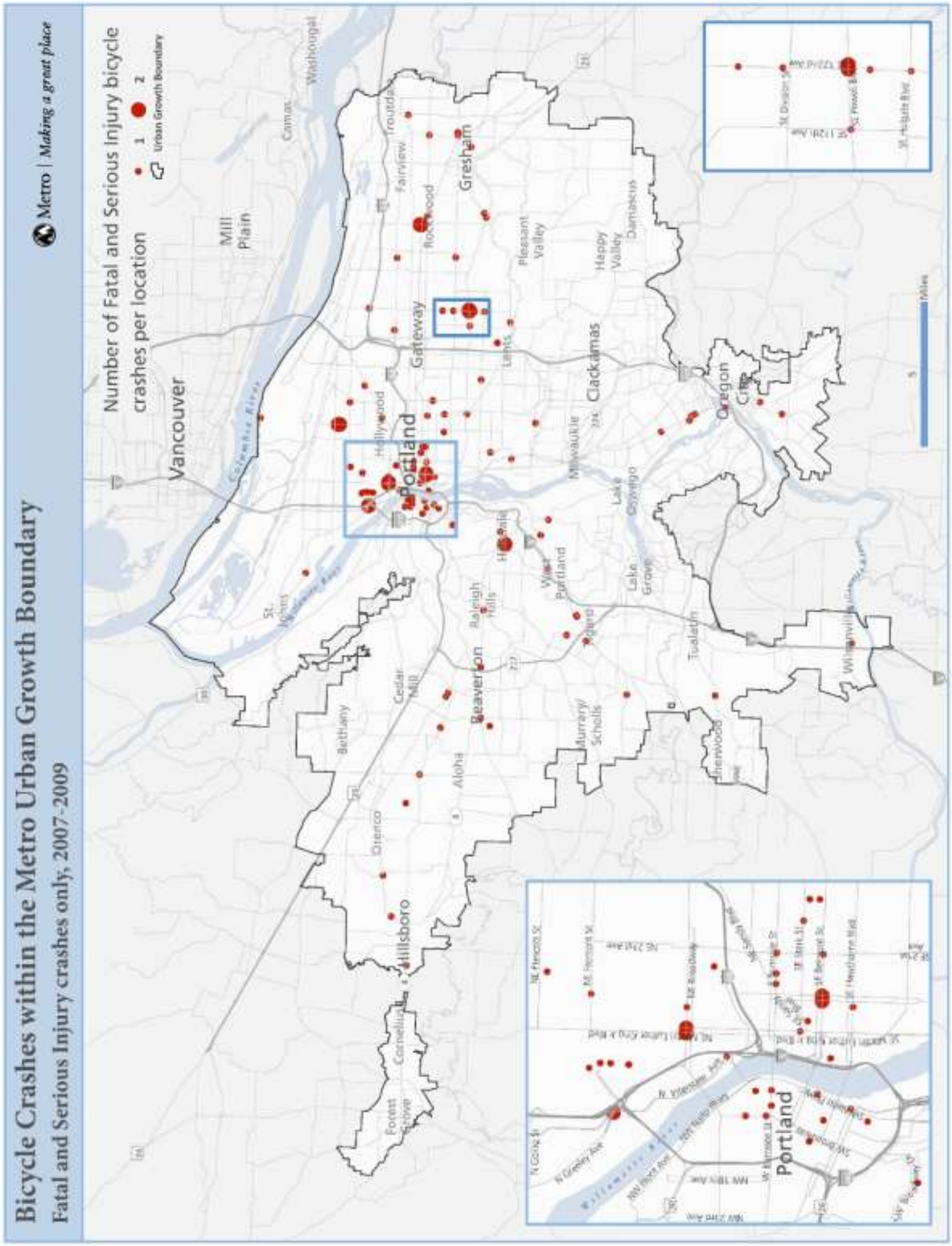

Crashes within the Metro Urban Growth Boundary
Non-Freeway Fatal and Serious Injury crashes only, 2007-2009
Metro | Making a great place
Number of Fatal and Serious Injury crashes per location
Urban Growth Boundary
Vancouver
Portland
Gresham
Beaverton
Hillsboro
Clackamas
Oregon City

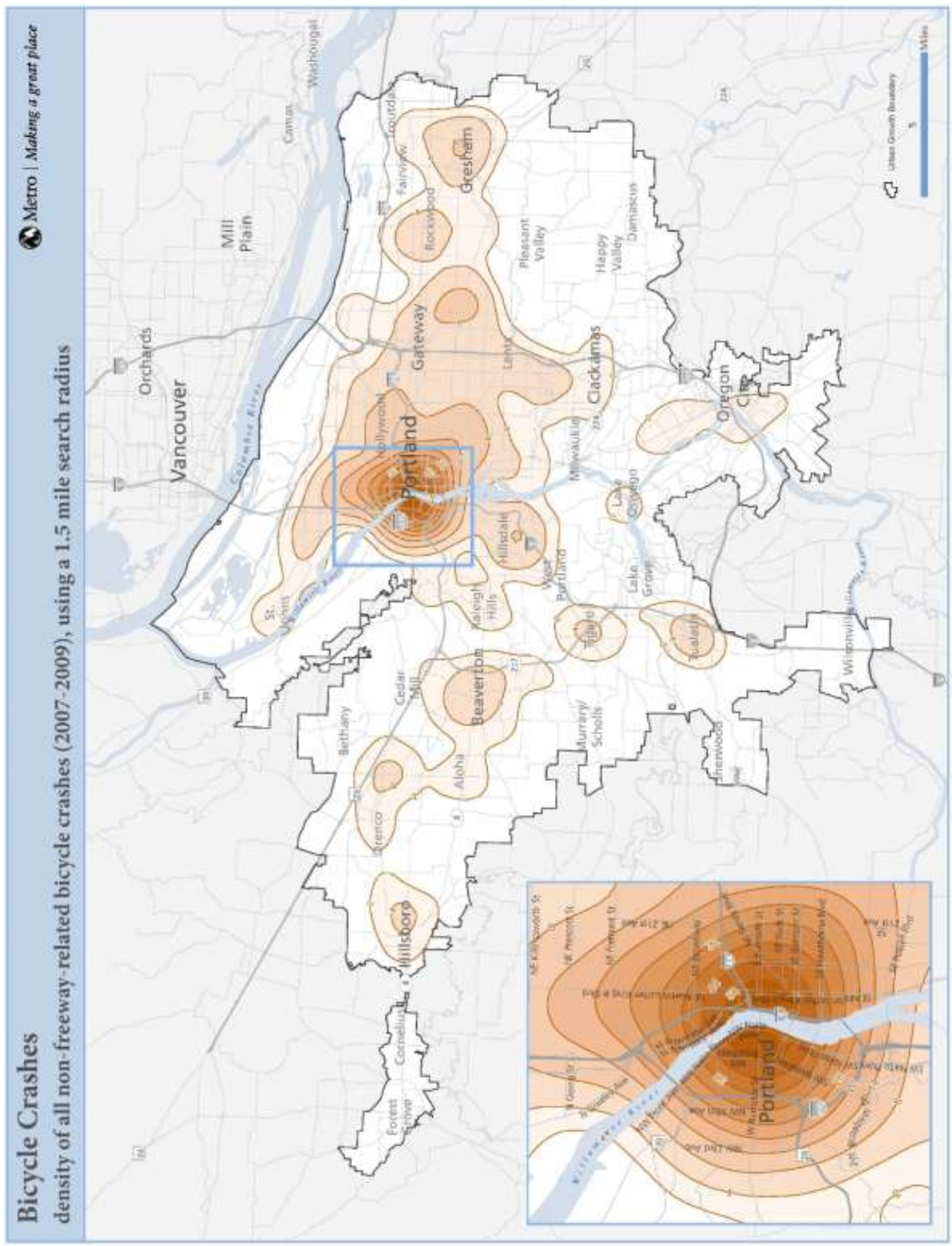

Automobile Crashes
density of all non-freeway-related fatal and serious injury crashes (2007-2009), using a 1.5 mile search radius
Metro | Making a great place
Vancouver
Orchards
Mill Plain
Camas
Washougal
Portland
Gresham
Gateway
Rockwood
Fairview
Troutdale
Hollywood
Lents
Clackamas
Milwaukie
Oregon City
Lake Oswego
Pleasant Valley
Happy Valley
Damascus
Hillsdale
West Portland
Raleigh Hills
Beaverton
Tigard
Tualatin
Lake Grove
Wilsonville
Sherwood
Murray/Scholls
Cedar Mill
Bethany
Aloha
Orenco
Hillsboro
Cornelius
Forest Grove
St. Johns
Urban Growth Boundary
Miles

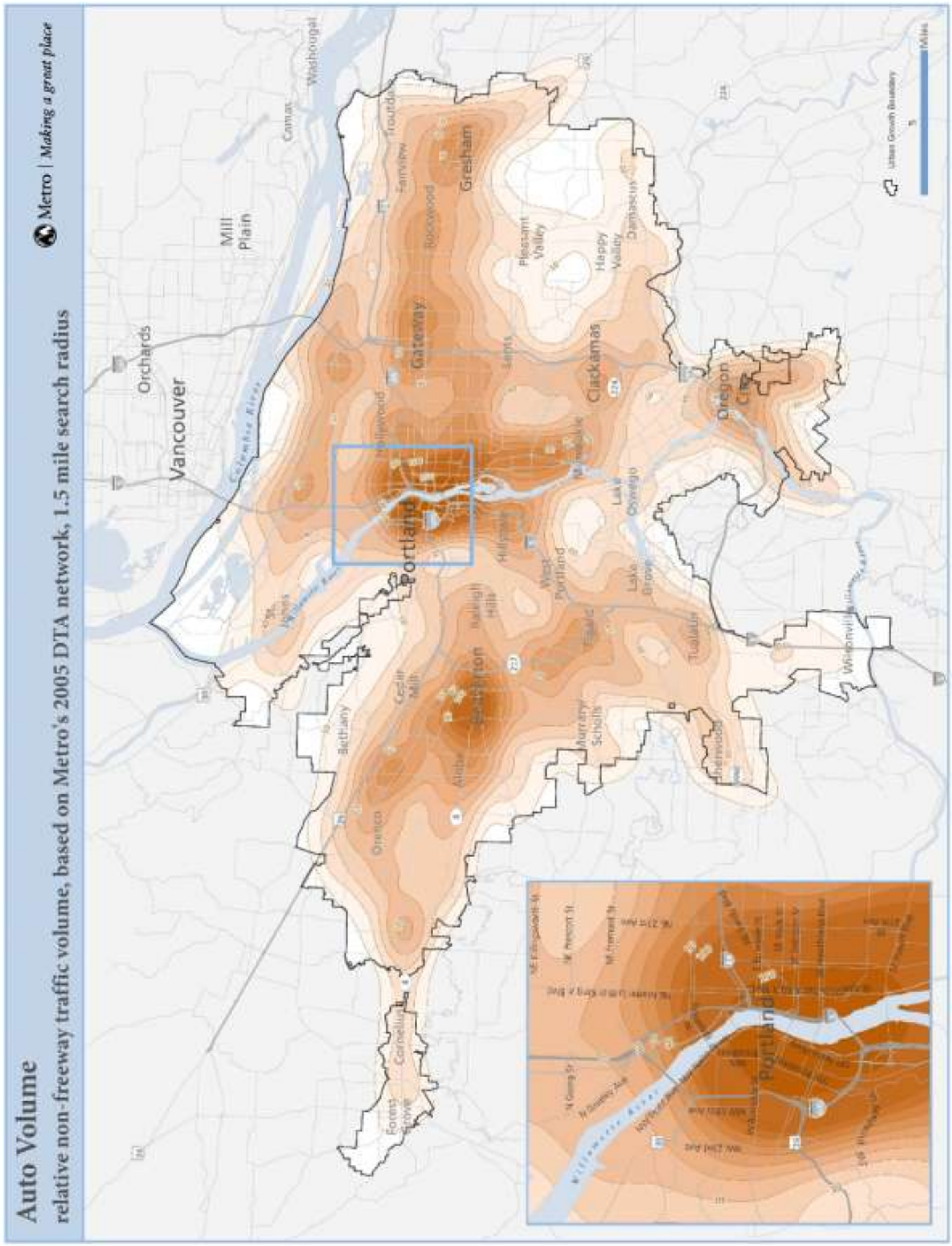

Freeway Crashes within the Metro Urban Growth Boundary
Fatal and Serious Injury crashes occuring on the freeway system (including freeway ramps), 2007-2009
Metro | Making a great place
Number of Fatal and Serious Injury crashes per location
1
2
3
4
5 - 6
Urban Growth Boundary
Vancouver
Mill Plain
Camas
Washougal
Troutdale
Fairview
Gresham
Rockwood
Gateway
Hollywood
Portland
Pleasant Valley
Happy Valley
Damascus
Clackamas
Milwaukie
Oregon City
Lake Oswego
Lake Grove
Hillsdale
West Portland
Raleigh Hills
Tigard
Tualatin
Wilsonville
Sherwood
Murray/Scholls
Beaverton
Aloha
Bethany
Cedar Mill
Orenco
Hillsboro
Cornelius
Forest Grove
St. Johns
Miles

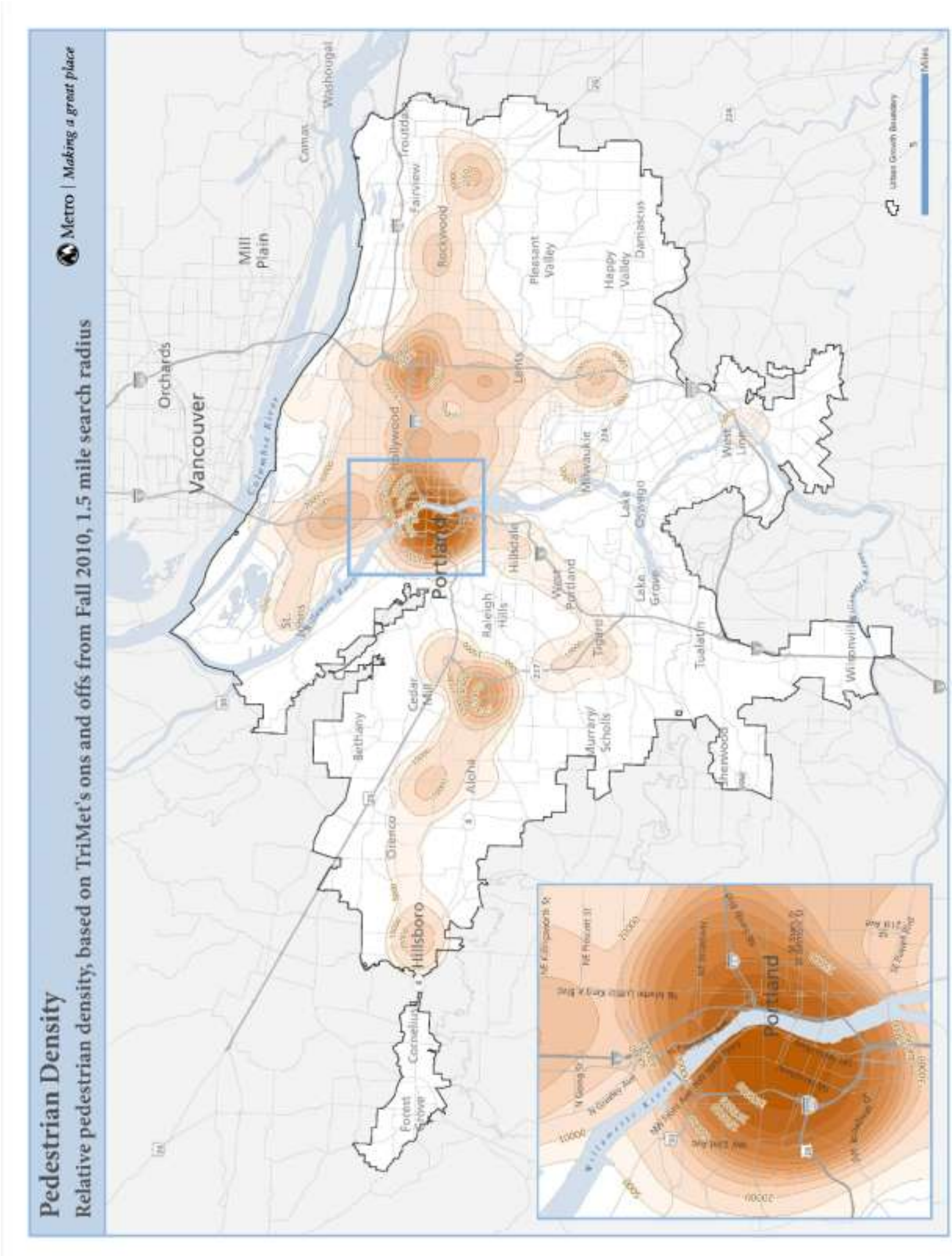

Pedestrian Crashes within the Metro Urban Growth Boundary
Fatal and Serious Injury crashes only, 2007-2009
Number of Fatal and Serious Injury pedestrian crashes per location
1
2
Urban Growth Boundary
Metro | Making a great place
Vancouver
Mill Plain
Camas
Washougal
Troutdale
Fairview
Gresham
Rockwood
Gateway
Portland
Hollywood
Lents
Clackamas
Pleasant Valley
Happy Valley
Damascus
Milwaukie
Lake Oswego
Oregon City
Hillsdale
West Portland
Lake Grove
Raleigh Hills
Beaverton
Tigard
Tualatin
Wilsonville
Murray/Scholls
Sherwood
Cedar Mill
Bethany
Aloha
Orenco
Hillsboro
Cornelius
Forest Grove
Miles


Pedestrian Crashes
density of all non-freeway-related pedestrian crashes (2007-2009), using a 1.5 mile search radius
Metro | Making a great place
Vancouver
Orchards
Mill Plain
Camas
Washougal
Portland
Hollywood
Gateway
Rockwood
Gresham
Fairview
Troutdale
Lents
Pleasant Valley
Happy Valley
Damascus
Clackamas
Milwaukie
Oregon City
Lake Oswego
West Portland
Hillsdale
Raleigh Hills
Lake Grove
Tualatin
Wilsonville
Tigard
Beaverton
Cedar Mill
Bethany
Murray Scholls
Sherwood
Aloha
Orenco
Hillsboro
Cornelius
Forest Grove
St. Johns


Bicycle Crashes within the Metro Urban Growth Boundary
Fatal and Serious Injury crashes only, 2007-2009
Metro | Making a great place
Number of Fatal and Serious Injury bicycle crashes per location
1
2
Urban Growth Boundary
Vancouver
Mill Plain
Camas
Washougal
Troutdale
Fairview
Gresham
Rockwood
Gateway
Hollywood
Portland
Lents
Pleasant Valley
Happy Valley
Damascus
Clackamas
Milwaukie
Oregon City
Lake Oswego
Lake Grove
West Portland
Hillsdale
Raleigh Hills
St. Johns
Beaverton
Cedar Mill
Bethany
Aloha
Orenco
Hillsboro
Cornelius
Forest Grove
Murray Scholls
Tigard
Tualatin
Sherwood
Wilsonville
Columbia River
Willamette River
Miles


Bicycle Crashes
density of all non-freeway-related bicycle crashes (2007-2009), using a 1.5 mile search radius
Metro | Making a great place
Vancouver
Orchards
Mill Plain
Camas
Washougal
Portland
Gateway
Gresham
Rockwood
Fairview
Troutdale
Hollywood
Clackamas
Milwaukie
Oregon City
Lake Oswego
West Portland
Hillsdale
Raleigh Hills
St. Johns
Beaverton
Cedar Mill
Bethany
Aloha
Orenco
Hillsboro
Cornelius
Forest Grove
Tigard
Tualatin
Wilsonville
Sherwood
Murray Scholls
Lake Grove
Pleasant Valley
Happy Valley
Damascus
Lents
Urban Growth Boundary
Miles


Auto Volume
relative non-freeway traffic volume, based on Metro's 2005 DTA network, 1.5 mile search radius
Metro | Making a great place
Vancouver
Orchards
Mill Plain
Camas
Washougal
Troutdale
Fairview
Gresham
Rockwood
Gateway
Hollywood
Portland
Pleasant Valley
Happy Valley
Damascus
Clackamas
Milwaukie
Lake Oswego
Oregon City
West Portland
Hillsdale
Raleigh Hills
Beaverton
Cedar Mill
Bethany
Aloha
Orenco
Murray Scholls
Tigard
Tualatin
Sherwood
Wilsonville
Cornelius
Forest Grove
St. Johns
Urban Growth Boundary
Miles


Pedestrian Density
Relative pedestrian density, based on TriMet's ons and offs from Fall 2010, 1.5 mile search radius
Metro | Making a great place
Vancouver
Orchards
Mill Plain
Camas
Washougal
Troutdale
Fairview
Rockwood
Gresham
Pleasant Valley
Happy Valley
Damascus
Hollywood
Lents
Milwaukie
Lake Oswego
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Portland
Hillsdale
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Raleigh Hills
Tigard
Tualatin
Wilsonville
Lake Grove
Sherwood
Murray/Scholls
Beaverton
Cedar Mill
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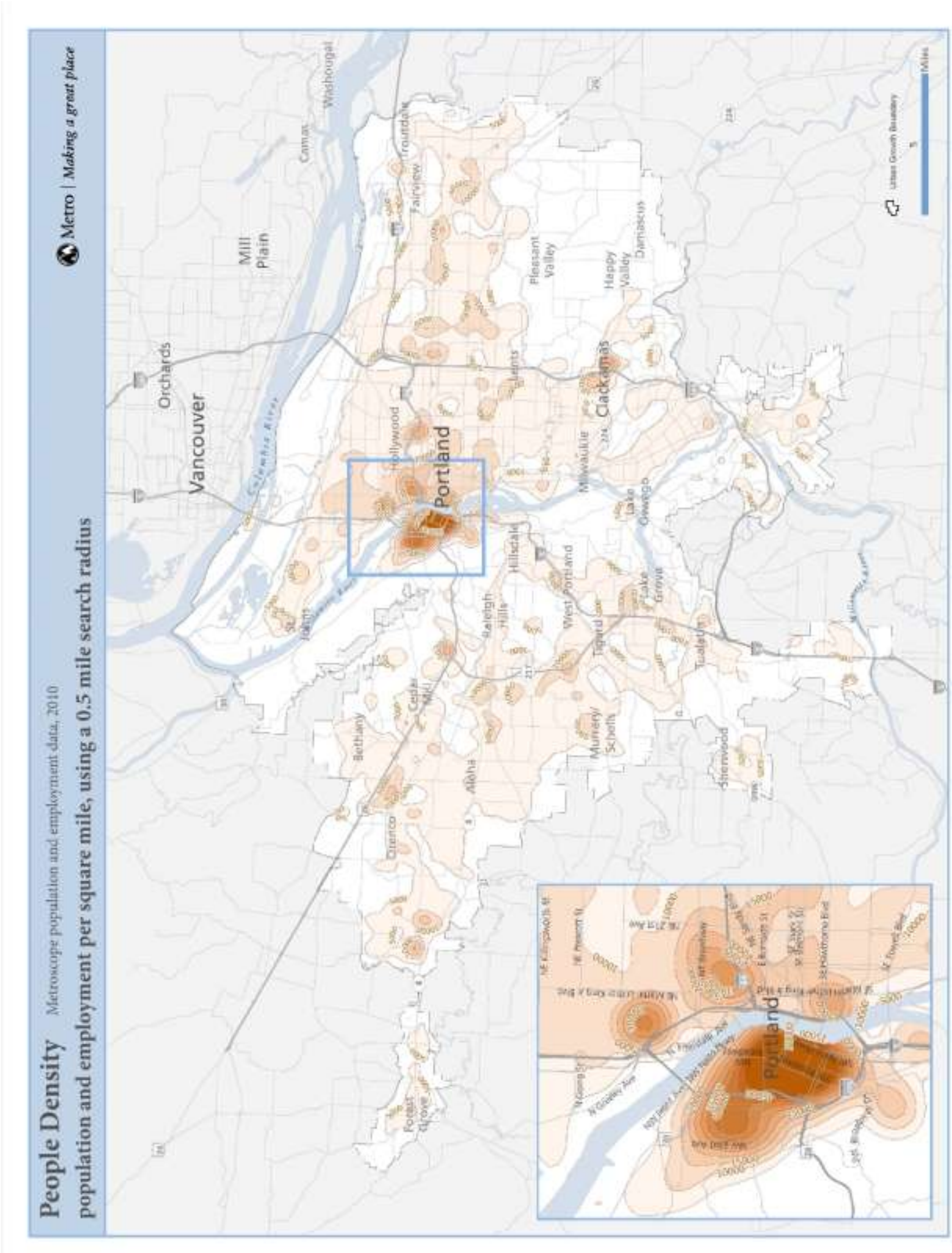
Cornelius
Forest Grove
St. Johns
Portland


People Density
Metroscope population and employment data, 2010
population and employment per square mile, using a 0.5 mile search radius
Metro | Making a great place
Vancouver
Orchards
Mill Plain
Camas
Washougal
Troutdale
Fairview
Portland
Hollywood
Gresham
Pleasant Valley
Happy Valley
Damascus
Clackamas
Milwaukie
Lake Oswego
West Portland
Hillsdale
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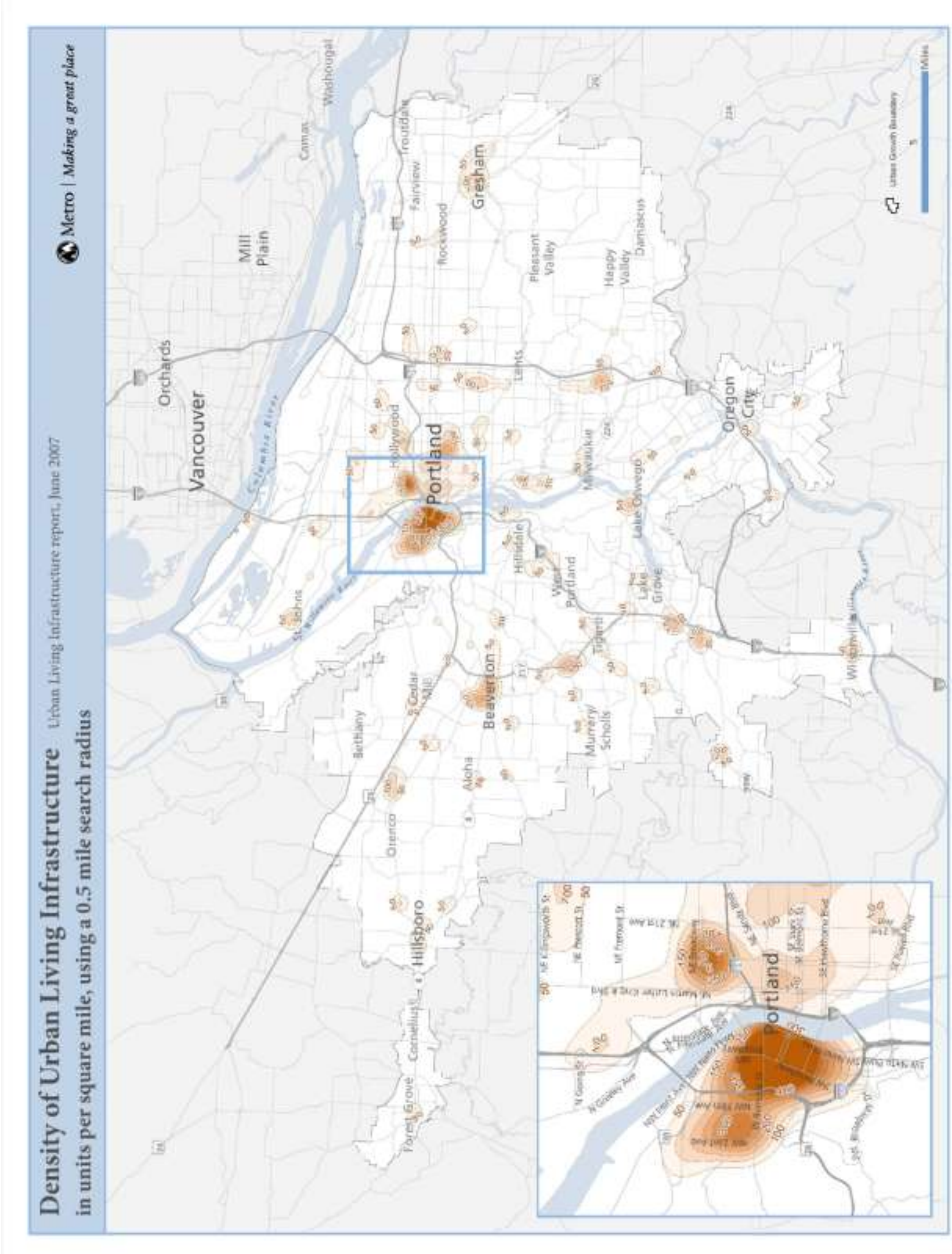
Tigard
Tualatin
Lake Grove
Murray/Scholls
Sherwood
Bethany
Cedar Mill
Aloha
Orenco
Forest Grove
Columbia River
Urban Growth Boundary
Miles


Density of Urban Living Infrastructure
Urban Living Infrastructure report, June 2007
in units per square mile, using a 0.5 mile search radius
Metro | Making a great place
Vancouver
Orchards
Mill Plain
Camas
Washougal
Troutdale
Fairview
Gresham
Rockwood
Pleasant Valley
Happy Valley
Damascus
Portland
Hollywood
Lents
Milwaukie
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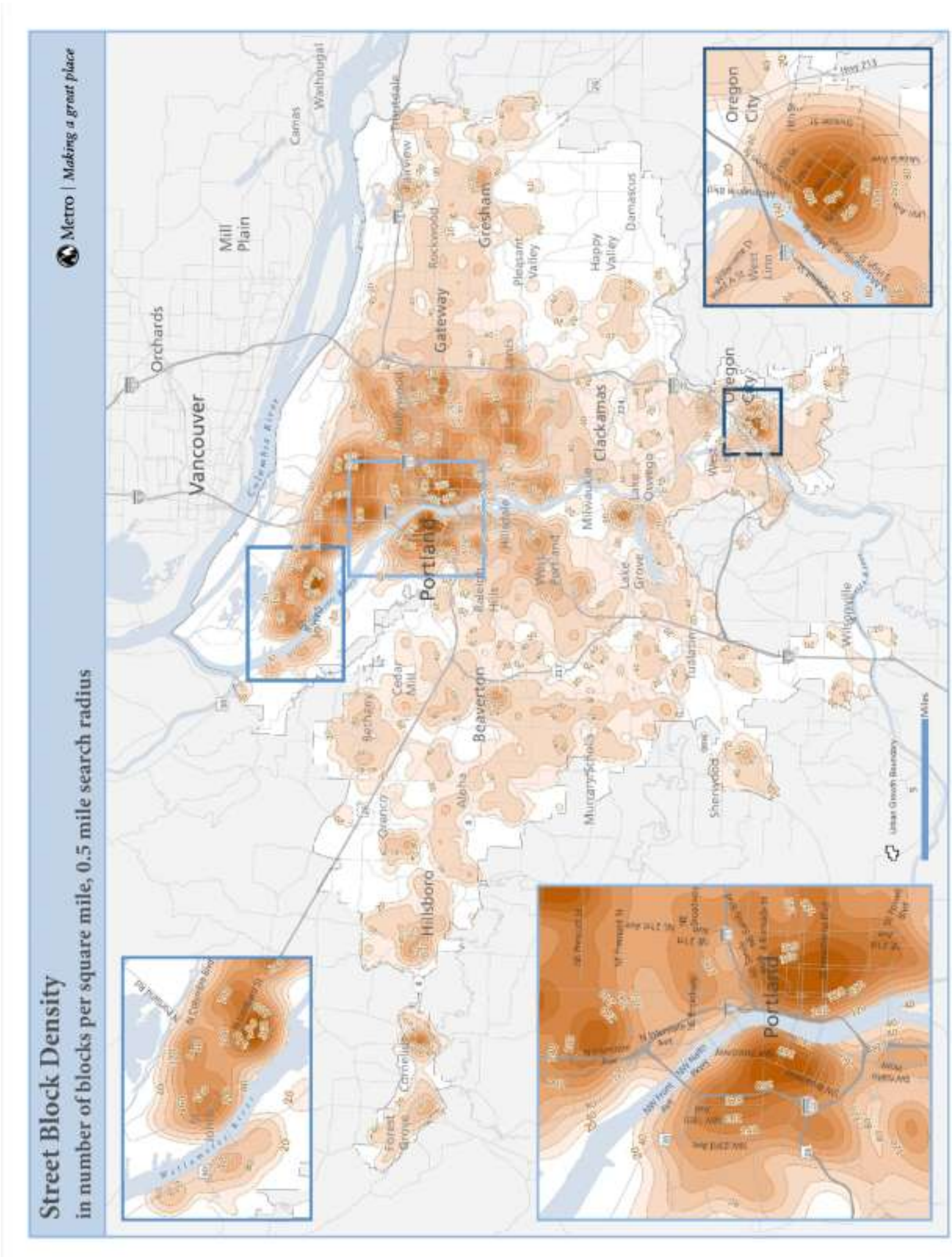
Lake Grove
Hillsdale
West Portland
St. Johns
Tigard
Beaverton
Cedar Mill
Bethany
Murray/ Scholls
Aloha
Orenco
Hillsboro
Cornelius
Forest Grove
Wilsonville
Columbia River
Portland


Street Block Density
in number of blocks per square mile, 0.5 mile search radius
Metro | Making a great place
Vancouver
Orchards
Mill Plain
Camas
Washougal
Troutdale
Fairview
Gresham
Rockwood
Gateway
Pleasant Valley
Happy Valley
Damascus
Clackamas
Oregon City
Milwaukie
Lake Oswego
West Linn
Portland
Raleigh Hills
West Portland
Lake Grove
Tualatin
Wilsonville
Sherwood
Beaverton
Cedar Mill
Bethany
Aloha
Murrayhill
Orenco
Hillsboro
Cornelius
Forest Grove
Urban Growth Boundary
Miles